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Burn Bolt
CATAPILLER

LAST ONE!

Customer gets a copy

Return this to the floor

LAST ONE!

Dranetz

656 Series

QA Vol. 1

TM-112775

WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) or any other requirements, or both, which may be applicable to the user.

Installation, operation, and maintenance should only be performed by qualified personnel.

TM-112775

VOLUME 1 -- OPERATOR'S MANUAL

SERIES 656

DISTURBANCE WAVEFORM ANALYZER

1 August 1987

Rev. A: 15 January 1988
Rev. B: 15 April 1988

See opposite side relative to proprietary rights.

Note: Refer to Volume 2 (Service Manual) of TM-112775 for maintenance information.

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DRANETZ

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This instrument is being used for:

___Field Service ___Rental
___Development Eng. ___Facility Eng.
___Other_____
(Please Specify)

RETURN THIS APPLICATION TO: Dranetz Service Corp./Subsidiary of Dranetz Technologies, Inc./2259 South Clinton Ave./Building 1/South Plainfield/New Jersey/07080.

IMPORTANT! CALIBRATION INTERVAL

The recommended calibration interval for this unit is once every **5 YEARS.**

We recommend that you return the unit to the factory for calibration. If you decide to do so, first contact Dranetz Service Corp. to obtain an authorization number.

Telephone Number: (201) ~~755-7081~~ 287-3680
Telex Number: 499-7808
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Then fill out the Repair/Service Order form enclosed in this manual and ship it along with the unit to Dranetz Service Corp. (If this form is missing, ask Dranetz Service Corp. for a replacement.)

BATTERY PACK REPLACEMENT

This unit also contains an internal battery pack. For optimal use and reliability, we recommend that you have the battery pack replaced once every **2 YEARS.**

Replacement is performed at Dranetz Service Corp. by following the same procedure described above.

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CAUTION

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this instruction manual, the instrument may cause interference to radio communications. It has been tested and found to comply with the limits for a Class "A" computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the instrument is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his or her own expense, will be required to take whatever measures are necessary to correct the interference.

Figure 1-1. Series 656 Disturbance Waveform Analyzer

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VOLUME 1
OPERATOR'S MANUAL

SERIES 656 DISTURBANCE WAVEFORM ANALYZER

SECTION I
GENERAL INFORMATION

1.1 SCOPE

This manual consists of two volumes. You are reading Volume 1, the Operator's manual, which is divided into three sections:

I. GENERAL INFORMATION
II. INSTALLATION AND OPERATION
III. OPERATIONAL TEST

Volume 2, the Service manual, contains the maintenance instructions and consists of four sections:

IV. THEORY OF OPERATION
V. MAINTENANCE AND CALIBRATION
VI. REPLACEABLE PARTS
VII. SCHEMATICS AND ASSEMBLIES

1.1.1 General Conventions on Reading this Manual

Buttons and switches are capitalized; single keystroke commands and function keys such as [RETURN], [BACK SPACE], [SHIFT], etc., are indicated within brackets.

Screen displays of printouts and graphs are set away from the text. Read all printouts from left to right and from top down.

1.2 INTRODUCTION

The Series 656 Disturbance Waveform Analyzer is a powerful, self-contained, portable unit. The Series 656 captures, records, analyzes, and displays ac and dc power disturbances. The graphics and data displays can be viewed on the unit's CRT screen or printed for hard copy analysis.

NOTE

Refer to Appendix D for example waveform disturbances.

1.2.1 Operational Overview

Monitoring
The Series 656 has four Main channels (A, B, C, and D) which monitor ac voltage, neutral-to-ground voltage, or dc voltage on either a low (0 to 58 volts) or high range (0 to 580 volts).

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Primary Synchronization Channel
By convention, channel A is the primary synchronization channel. If synchronization is lost on channel A, the Series 656 automatically switches to the next active channel (B, C, or D). The synchronization channel must be set up on the high range (0 to 580 volts) for the Series 656 to operate properly.

Capturing the Reference Waveform
When you turn on the Series 656, you'll hear two beeps indicating that the reference waveform, frequency, and Sensor (transducer) channel readings have been captured. If you want to update the reference waveform or if you want to get a "snapshot" of the current conditions, use the following sequence: From the Main Menu press [4] to go into the Monitoring Functions Menu and then press [1] to go into Main Channel Setups (the setup that's currently active is displayed). Press [A] to reactivate this setup. You'll then hear two beeps indicating that new waveform, frequency, and sensor readings have been captured.

Event Recording
The Series 656 records an event on a Main channel with any of the following four occurrences:

- When the monitored voltage waveform for a channel differs by more than the programmed VOLTAGE value from the last cycle of the last event for that channel.

- When impulse amplitude on a channel exceeds the IMPULSE sensitivity threshold (V peak) for that channel.

- When the Synchronization channel's frequency (averaged over 20 cycles) changes from the last recorded frequency by more than the programmed FREQUENCY value.

- Optionally: When a Sensor (transducer) channel's input changes from the previous reading by more than the programmed sensitivity for that channel.

The event cycle ends when the line, frequency, or monitored Sensor (transducer) channel stabilizes.

NOTE

RMS voltages are calculated on a single cycle by cycle basis from positive zero crossing to the next positive zero crossing.

Diagnosing Power Problems
Refer to Section II of this manual for detailed instructions of the following menus. These menus are simply a brief example of how you could diagnose power problems.

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Power problems can be diagnosed as follows:

(1) Starting at the unit's Main Menu:

```
          M A I N   M E N U
1 Graphic Summaries...
2 View Events...
3 Status Screen
4 Monitoring Functions...
5 Disk Operations...
6 Other Functions...
7 HELP !
```

(2) If you pressed the [1] key to go into the Graphic Summaries Menu, it would appear:

```
      Graphic Summaries Menu
1 Plot RMS/Impulse Summary
2 Plot Frequency Summary
3 Plot Sensor Channel Summary


6 Return to Main Menu
7 HELP !
```

(3) If you then pressed the [1] key to go into the Plot RMS/Impulse Summary Menu, it would appear:

```
      Plot RMS/Impulse Menu
1 Channel to be Plotted: A
2 Plot Multiple Days...
3 Plot Any Day by Hour...
4 Plot Previous 24 Hours
5 Plot Previous Hour
6 Return to Previous Menu
7 HELP !
```

(4) Pressing [1] at this point would alternate the channel from "A" to "B" to "C" to "D" to "A", etc. Once the proper channel is displayed, you could then press [2], [3], [4], or [5], depending on the time span you want to examine. For example: If you pressed [2] to plot multiple days and then entered a starting and ending date, an RMS/Impulse plot of events in memory between these dates would be displayed (for example, 7/07/87 - 7/09/87).

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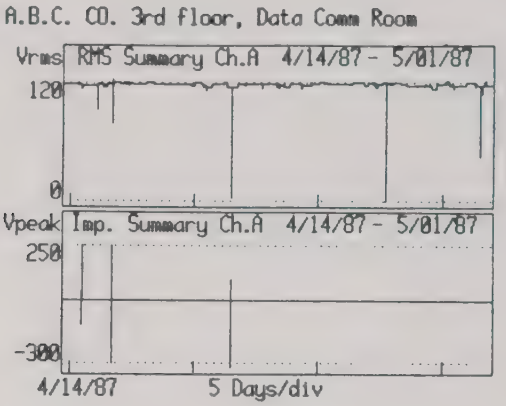
A display (such as the following) would appear:



The above display illustrates rms voltage changes (top) and impulses (bottom) recorded from 4/14/87 through 5/1/87.

(5) If desired, you could press [T] to get a written description of the display. If you did so, a new display (such as the following) would appear:

Ch. A RMS/Impulse Plot Summary

A.B.C. CO. 3rd floor, Data Comm Room

Start on Event # 1 End on Event # 206
Start Time: 4/14/87 17:10
End Time: 5/01/87 23:59

Worst RMS Events
Max Value = 123.1 Vrms Event # 50
Min Value = 0.0 Vrms Event # 142

Impulse Events = 4
Worst Pos Value = 252 Vpeak Event # 38
Worst Neg Value = -324 Vpeak Event # 88

The above display is a text description of the RMS/Impulse Plot summary. Note: The start time is 5:10 p.m. because that's the time the first event was recorded on 4/14/87.

(6) Once you have an overall picture of the events which have occurred, you can narrow the interval to be searched or you can view specific event numbers (refer to Section II).

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1.2.2 Using a Keyboard, Touch-Screen, and Zoom-Box

Basic knowledge of a typewriter style keyboard is assumed.

The touch-screen lets you quickly make screen selections by applying gentle pressure with your index finger to the area of the selection. When you slide you finger up and down the screen (without releasing), the area you are currently on will highlight. If there are several selections on a line, each will highlight as you move your finger across the screen. A function is selected when you release your finger from a highlighted area.

The Series 656 has a "zoom-box" feature which lets you enlarge any portion of a displayed waveform. You generally move the zoom-box around by placing your index finger on the corner of the box you wish to move in or out, and then sliding your finger slowly across the touch-screen. The two adjacent sides of the box will move with your finger. When the box is at its new position, lift your finger from the screen and the new box will remain in place.

1.3 FEATURES

The Series 656 Disturbance Waveform Analyzer (see Figure 1-1) is more briefly referred to as the Series 656 or Mainframe. The Series 656 operates on microprocessor based hardware and is a completely self-contained portable unit with features including:

-- Two powerful MC68000 16-/32-bit microprocessors,

-- Menu prompts with accessible "HELP" displays,

-- Four Main channel inputs,

-- Eight optional Sensor (transducer) channel inputs,

-- Two RS-232C graphics compatible serial ports,

-- A high-resolution CRT with touch-screen overlay,

-- A fold-down, typewriter style keyboard,

-- A built-in high-resolution thermal printer,

-- Dual 3-1/2 inch microfloppy disk drives,

-- A built-in real-time clock with 10mS resolution,

-- Ability to "zoom" in on waveforms for detailed transient analysis,

-- One-half megabyte of non-volatile memory for long-term monitoring and data storage, and

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1.3.1 Distinctive Operation

Most analyzers to date print events on paper as they occur. One of the drawbacks of this is that unwanted data is printed and paper is wasted.

The Series 656, on the other hand, is distinct in that it internally stores large amounts of event data without necessarily printing or displaying them. When you want to see a graphic summary of the events that have occurred, you go through the Graphic Summaries Menu to display them. You can also go to the View Events Menu to view a particular event. If you want a paper printout (for reports, analysis, etc.), the Series 656 or an attached printer can print a copy of the individual event, or a graphic summary of a series of events. This information can be used to correlate events with times of occurrence and severities.

In short, the Series 656 lets you perform broad or detailed event analysis. In a broad sense it can display a series of related events while in a detailed sense it can display a high resolution view of an individual event.

1.4 APPLICATIONS AND PURPOSE

The Series 656 captures, records, analyzes, and displays power line disturbances affecting reliable operation of sensitive electronic, computer-based equipment.

You can instantly recall and display stored power line disturbance waveforms for detailed summary analysis.

Using your finger (or keyboard) to move the zoom-box, you can define a specific portion of a waveform, and then instantly zoom in for an enlarged view of the boxed region. The smaller your zoom-box, the more it will be enlarged with each "zoom", because the zoom-box expands to a full screen.

The Series 656 can be preset to record only those disturbance events exceeding your threshold criteria. Once recorded, these disturbances can be analyzed on screen, saved to a diskette for filing, printed for hard copy analysis, or transmitted to another Series 656 via a modem or direct connection.

1.5 GENERAL OVERALL DESCRIPTION

Front and rear panel views of the Series 656 are illustrated in Figures 1-2 and 1-3 on the following two pages.

Subsections 1.5.1 and 1.5.2 list the visible parts of the front and rear panels. (The keyboard is part of the front panel.)

Subsections 1.6 through 1.6.10 describe the main sections of the Series 656, including the connecting cables.

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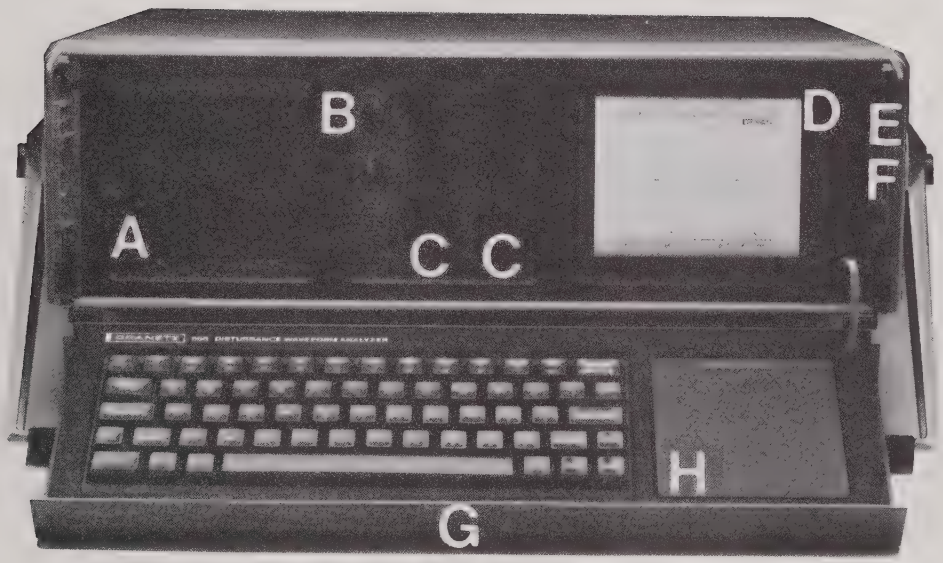

Figure 1-2. Series 656 Front Panel View

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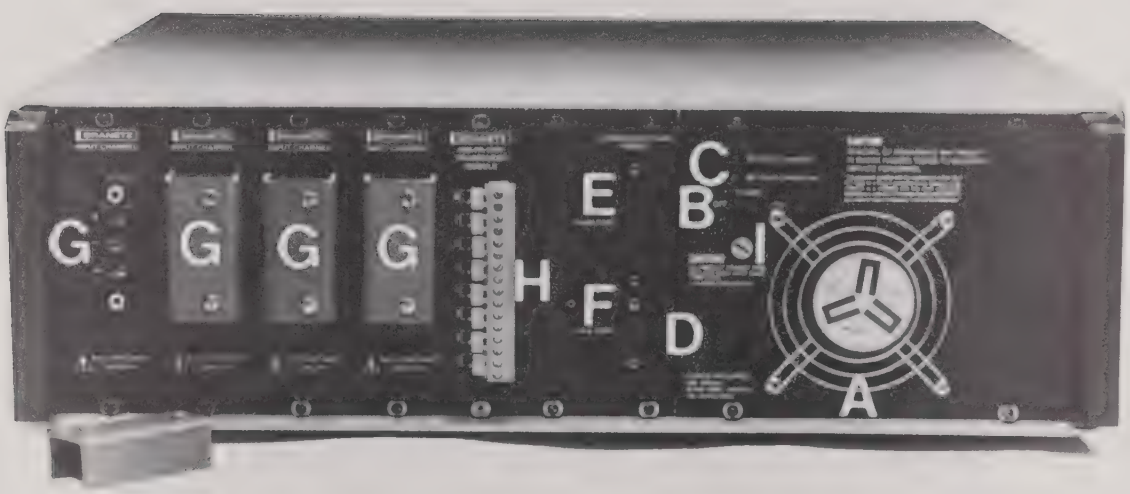

Figure 1-3. Series 656 Rear Panel View

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1.5.1 Front Panel

The front panel of the Series 656 is illustrated in Figure 1-2. (Since the keyboard folds down, it is considered part of the front panel.) The basic layout of the front panel is listed in the call-outs on the illustration which are identified below.

(A) Five inch high-resolution CRT with touch-screen

(B) A SETUP knob for default setup at power-on and a second knob reserved for future use.

(C) Two 3-1/2 inch microfloppy disk drives:

-- Events, setups, or both are stored and retrieved on a disk in the left-hand disk drive.

-- The right-hand disk drive is used for loading the Series 656 System Disk; it is also used when copying disks.

(D) Thermal Printer

(E) PAPER FEED button

(F) CANCEL printout in progress button

(G) Fold-down, typewriter style keyboard

(H) Diskette storage compartment

1.5.2 Rear Panel

The rear panel of the Series 656 is illustrated in Figure 1-3. (The basic layout of the rear panel is listed in the call-outs on the illustration which are identified below.

(A) Power Supply Fan

(B) ON/OFF switch

(C) "BATTERY CHARGED" and "BATTERY OPERATING" LEDs

(D) AC Power Cord 3-Pronged Receptacle

(E) Main Port (25-Pin RS-232C Serial Port)

(F) Auxiliary Port (9-Pin RS-232C Serial Port)

(G) Four Main Channel Inputs

(H) Eight Optional Sensor (Transducer) Channel Inputs

(I) Fuse

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1.6 SERIES 656 INPUT AND OUTPUT SECTIONS

The subsections under 1.6 contain information on the input and output sections of the Series 656.

1.6.1 Thermal Printer

CAUTION

NEVER allow the printer to operate without paper; doing so could damage the print head.

The Series 656 thermal printer provides paper printouts of screen displays. Since the Series 656 has a CRT, the printer is basically a secondary output device for printing anything viewed on the screen. You can get a printout of any screen at any time by holding down [CONTROL] and pressing [P].

1.6.1.1 Reading the Display

The printer's display is the same orientation as the screen's display: left to right across the page.

1.6.1.2 Changing a Roll of Thermal Paper

(1) Stand the Mainframe in its operating position on a flat surface with its keyboard folded down.

(2) Tear off any remaining paper from the printer and press and hold the PAPER FEED button to empty any paper left between the print head.

(3) Press in on the center of the printer door and release. This will unlock the printer assembly and it will partially slide out.

(4) Pull the chassis out until it stops.

(5) Lift the empty roll straight out from the U-shaped slots.

(6) Slide the plastic paper spool shaft out from the inside of the empty roll and install it in a new roll.

(7) Install the new roll (with spool shaft) into the U-shaped slots, oriented so the paper feeds from the back of the roll, going up.

(8) Using scissors, make a straight cut across the leading edge of the paper.

(9) Feed the paper about a 1/4 inch into the lower "in" feed slot (just above the roll).

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(10) While gently working the paper into the printer, press and hold the PAPER FEED button until the paper goes through the print head and reappears through the "out" feed slot just below the tear-bar (3/4 of an inch above the "in" slot).

NOTE

Make sure the paper feeds evenly.

(11) Push the printer assembly in until it locks. The paper should be visible just below the tear-bar. If not, press and hold the PAPER FEED button until it comes into view.

1.6.1.3 Paper Take-up Feature

If you don't want the printed paper to hang from the unit, you can use the take-up feature to accumulate the paper internally.

(1) Press and hold the PAPER FEED button until there are 9 inches of paper hanging.

(2) Unscrew the thumb screw on the printer door and swing the door up, exposing the paper take-up spool.

(3) Remove the take-up spool from the brackets by gently bending out the left-hand clip and pulling the spool down off the right-hand clip.

(4) Using scissors, make two cuts on the leading edge of the paper to form a slight point.

(5) Insert the pointed end of the paper into the groove on the paper spool. Wind the paper toward you several times (like loading 35mm film) until the slack is taken up. The winding is clockwise when viewed from your left.

(6) Insert the spool up into the right-hand clip while slightly bending out the left-hand clip and then press in the left-hand clip to lock the spool back into place.

(7) Close the door, tighten the thumb screw, and press the PAPER FEED button to make sure the paper advances properly.

Removing a portion of Paper from the Take-up Spool

To remove a portion of paper from the take-up spool:

a) Pull the printout from behind to create slack, tear the paper at the tear-bar, and then remove the take-up spool (see steps 2 and 3 above).

b) After removing the paper from the take-up spool, press and hold the PAPER FEED button until there are 9 inches of paper hanging, and then repeat steps 4 through 7 above.

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1.6.1.4 Reordering Thermal Paper

Thermal paper for the Series 656 thermal printer, P/N 110888, may be reordered from your authorized Dranetz representative or by calling or writing:

Dranetz Technologies, Inc.
Attn: Order Entry
P.O. Box 4019
Edison, NJ 08818-4019
(201) 287-3680

CAUTION

Use of thermal paper other than that supplied by Dranetz Technologies, Inc. or it's authorized representatives (P/N 110888) may damage the print head.

1.6.2 CRT with Touch-Screen

The glare-resistant CRT provides menu displays for guiding you through the unit's operation, lists "HELP" screens describing menu choices and what they mean, and displays high-resolution pictures of waveforms and text displays. When a waveform is displayed, the CRT also allows you to zoom in on a portion of a waveform to take a closer look. In short, the CRT is the unit's main way of communicating with you.

The touch-screen lets you select information just by touching a portion of the screen. It also lets you define a zoom-box region using your index finger to move the sides of the zoom-box (see Subsection 1.2.2).

1.6.3 Dual Microfloppy Disk Drives

The Series 656 has two 3-1/2 inch microfloppy disk drives. The left-hand drive is used for saving and loading system setups, events, or both. The right-hand drive is used for loading the Series 656 System Disk and for copying disks.

1.6.3.1 Microfloppy Diskettes

The Series 656 is shipped with one blank disk and two system disks (one labeled "656 Program" and the other labeled "656 Backup"). For best results, only use high quality double sided/ double density microfloppy diskettes if you need additional diskettes (boxes of 10 are available from Dranetz).

To write protect a microfloppy diskette, open the tab at the bottom corner of the diskette. When the slot is open, the disk is write protected; when the slot is closed, the disk may be written to.

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CAUTION

If your disk drives contained a protective insert card when you first unpacked the unit, DO NOT throw away these cards. To protect the heads of the disk drives in your unit, you MUST insert the cards whenever you transport the unit. If your disk drives did not contain protective insert cards, you have a disk drive setup that does not require protective insert cards. (Refer to Appendix C for a picture of these two disk drive setups.)

1.6.3.2 Cleaning the Disk Drives

After extended use, the disk drives may become dirty and require cleaning. Only use a quality 3-1/2 inch disk drive cleaning kit and follow the directions for preparing the cleaning disk.

To clean the left-hand disk drive, follow the procedure for initializing a disk, but use the cleaning disk and ignore the error messages that appear on the screen.

To clean the right-hand disk drive, insert the disk and attempt to use the cleaning disk as if it were a Series 656 system disk.

1.6.4 Keyboard

The fold-down typewriter style keyboard lets you do everything the touch-screen does. In addition, the keyboard lets you enter data and type comments (where applicable).

Descriptions of these keys and how they affect Series 656 operation are given in the applicable subsections in this manual.

1.6.5 Power Supply

The Power Supply module in the rear of the Mainframe furnishes the required power; the Series 656 may be operated within 90 to 250 V rms, 50 to 60 Hz. The supplied power cord attaches to the power cord receptacle. The module is cooled by a built-in fan and an ON/OFF rocker switch turns the Series 656 on and off.

1.6.5.1 Battery Pack

When the Series 656 is on, if the "BATTERY CHARGED" LED is lit, this indicates that the internal UPS (Uninterrupted Power Supply) battery pack is fully charged. If line voltage fails, the "BATTERY OPERATING" LED will light to indicate that the UPS is now operating. The UPS will maintain Series 656 operation for a period of time if power is temporarily lost.

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1.6.6 Communication Ports

There are two serial communication ports located on the rear panel, a Main Port and an Auxiliary Port:

Main Port - 25-pin, "D" type, RS-232C serial port for connection to a modem or other input/output device

Auxiliary Port - 9-pin, "D" type, RS-232C serial port for connection to an external printer or other output device

1.6.6.1 Main Port Description

The 25-pin connector provides an RS-232C compatible communication port for remote operation of the Series 656 using a modem or other input/output device. The port is configured as a DCE (Data Communications Equipment) and is fixed at 1200 baud. The definition and operation of the used pins in the 25-pin female "D" connector are described in Table 1-1.

Table 1-1. Main Port Pinouts

PIN	NAME	FUNCTION	DIRECTION	DESCRIPTION OF OPERATION
1	GND	Protective Ground	Not Applicable	Shield of interface cable should be connected to this pin which is tied to the internal frame ground of the Series 656.
2	RCV	Receive Data	Input	Series 656 receives serial data input from the connected device.
3	XMT	Transmit Data	Output	Series 656 sends output to the connected device.
7	GND	Signal Ground	Not Applicable	Internally connected to pin 1.

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1.6.6.2 Main Port and Null-Modem Cables

Connection of the Series 656 to a modem or other DTE I/O device may be made with a Dranetz Main Port cable (P/N 113445-G1). This cable connects to the 25-pin Main Port on the rear panel. (A Null-Modem cable [P/N 113446-G1] is required for DCE-to-DCE connection.) Table 1-1 illustrates the descriptions and Figures 1-4 (DCE-to-DTE) and 1-5 (DCE-to-DCE) illustrate the pinouts.

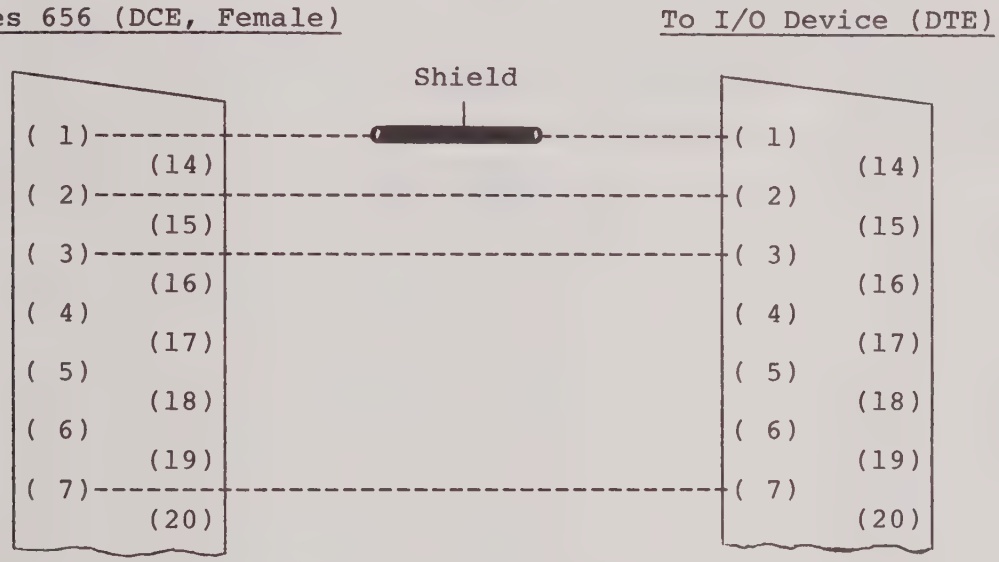

Figure 1-4. Main Port Cable Pinouts

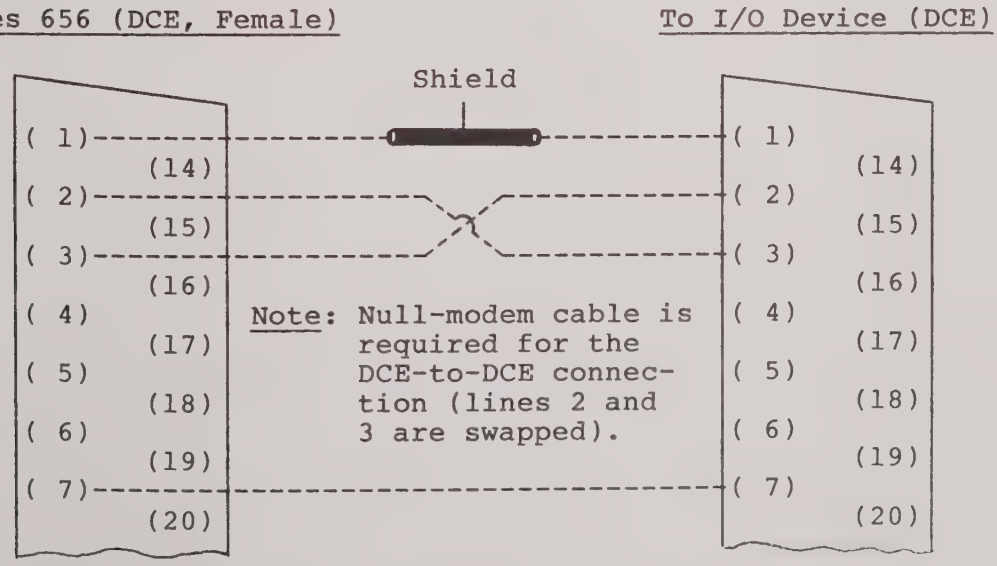

Figure 1-5. Null-Modem Cable Pinouts

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1.6.6.3 Auxiliary Port Description

The 9-pin connector provides a communication port for remote output using a printer. The port is configured as a DCE (Data Communications Equipment) and is fixed at 9600 baud. The definition and operation of the used pins in the 9-pin female "D" connector are described in Table 1-2.

Table 1-2. Auxiliary Port Pinouts

PIN	NAME	FUNCTION	DIRECTION	DESCRIPTION OF OPERATION
1	GND	Protective Signal Ground	Not Applicable	Shield of interface cable should be connected to this pin which is tied to the internal frame ground of the Series 656.
2	RCV	Receive Data	Input	Series 656 receives serial data input from the connected device. DTR must be TRUE for data to be recognized.
3	XMT	Transmit Data	Output	Series 656 sends output to the connected device, provided DTR is TRUE.
4	DTR	Data Terminal Ready	Input	This signal must be TRUE for the Series 656 to acknowledge the presence of a connected device. A FALSE state causes an immediate disabling of data transfer.

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1.6.6.4 Auxiliary Port Cable

Connection of the Series 656 to a remote printer or plotter may be made with a Dranetz Auxiliary Port cable (P/N 113447-G1). This cable connects to the 9-pin Auxiliary Port on the rear panel. Figure 1-6 illustrates the pinouts and Table 1-2 illustrates the descriptions.

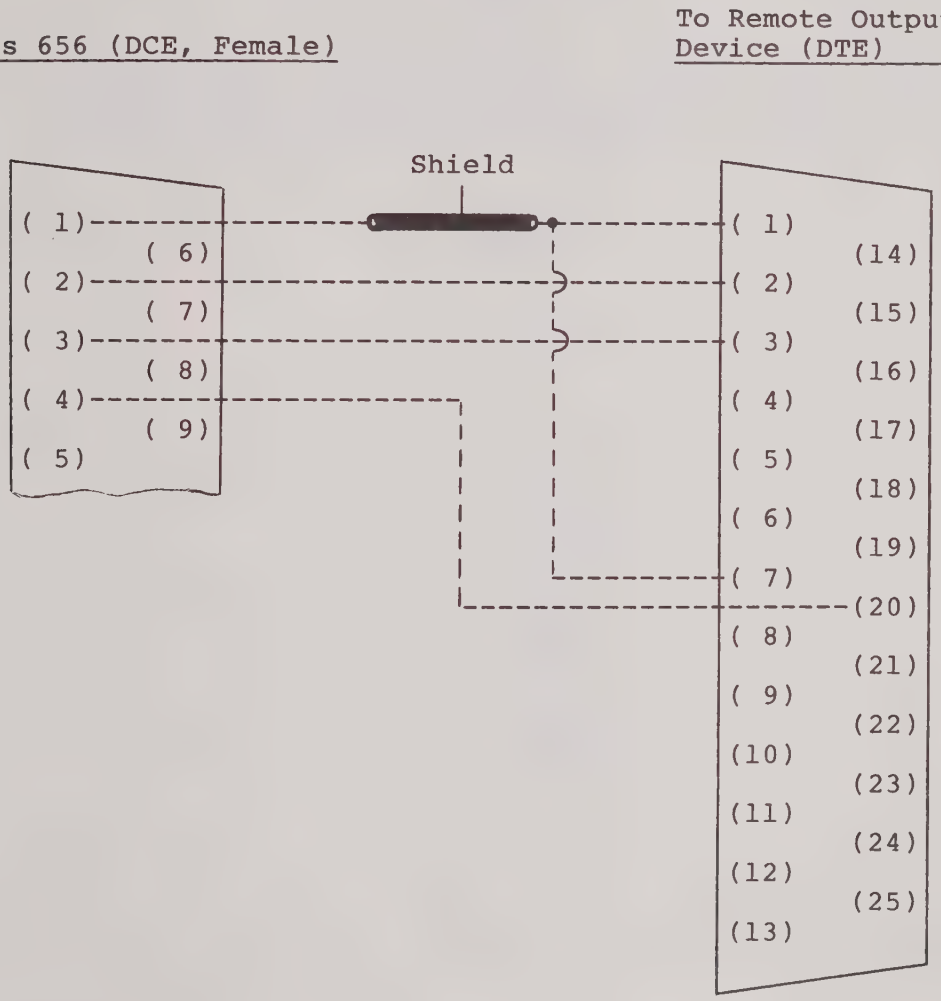

Figure 1-6. Auxiliary Port Cable Pinouts

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1.6.7 Main Channel Inputs

(For technical specifications, refer to Table 1-3 under Subsection 1.9.)

Four rear panel terminal strips allow the Series 656 to analyze synchronous, multi-phase ac power lines of 600 V rms or less.

WARNING

> Only uncover a terminal strip when wiring the input terminals, and only uncover the terminal strip you are currently working on. MAKE SURE THAT THE SERIES 656 IS OFF AND ALL POWER IS DISCONNECTED. At all other times, keep both the used and unused strips covered.

Each strip contains three terminal screws as illustrated in Figure 1-7:

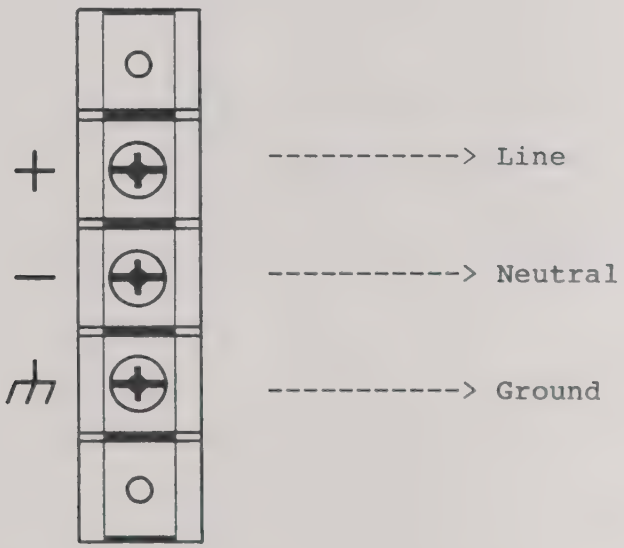

Figure 1-7. Typical Main Channel Input Barrier Strip

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1.6.8 Optional Sensor (Transducer) Channel Inputs

A single 16-position removable terminal block is provided for wiring up to eight Sensor channel inputs. The terminal block is labeled "Transducer Channels", although it is commonly referred to as Sensor channels in both this manual and on the display screens. This connector should be wired before it's inserted into the P.C.B. mounted housing located on the Sensor Monitor assembly. The connections are illustrated below in Figure 1-8.

CAUTION

Connect a supplied jumper between the "+" and "-" terminals of each channel that's not being used.

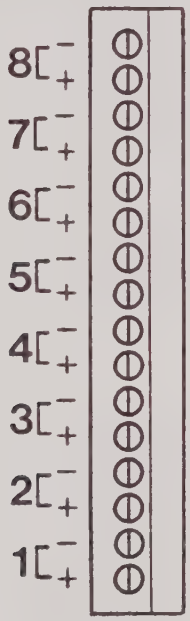

Figure 1-8. Typical Sensor (Transducer) Channel Inputs Barrier Strip

1.6.9 Real-Time Clock

A crystal-controlled (±25 PPM stability), real-time clock is built into the Series 656. The clock is battery backed with an estimated 10-year life. Time is presented as HH MM SS mm (hours, minutes, seconds, tens of milliseconds), in 24-hour military format with 10mS resolution.

1.6.10 Audible Beeper

The Series 656 produces a beep whenever it's turned on and whenever an event occurs. (The beeper can be turned on and off under the Other Functions Menu.)

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1.7 REMOTE OPERATION

Event data and system setups can be transferred between two Series 656 units. Event data and system setups are transmitted over the telephone lines using a modem at each Series 656 site. Event data and system setups can also be transmitted if the units are directly connected through an RS-232C cable of 50 feet or less.

The Series 656 that's waiting to receive event data and setups must be put in the "Wait for a Call" mode. In this mode it waits to be called while still continuing to monitor.

1.8 DATA TRANSMISSION OVER TELEPHONE LINES

The Series 656 transfers data over telephone lines using the CRC-XMODEM or CHECKSUM XMODEM file transfer protocol.

1.8.1 Series 656 Data Transfer to Personal Computers

There are a variety of software programs available in the marketplace that will allow your personal computer to perform data transfers over telephone lines. The Series 656 supports the popular CRC-XMODEM and CHECKSUM XMODEM as its data transfer protocols. Be sure that the program you are using supports one of these two protocols.

You can also use a direct connect RS-232C cable of 50 feet or less for your connection.

1.8.2 Main and Auxiliary Port Baud Rates

Data is transmitted through the Main Port at 1200 baud with 8 data bits, 1 start-bit, 1 stop-bit, and no parity or handshaking.

Data is transmitted through the Auxiliary Port at 9600 baud with 8 data bits, 1 start-bit, 1 stop-bit, and no parity or handshaking. An external printer may be connected to the Series 656 through this port. Printers which are known to be compatible with the Series 656 are the:

Hewlett-Packard ThinkJet,
Epson LX-800,
Apple Imagewriter, and
Okidata ML-192

Refer to their respective printer manuals for the proper dip switch selections.

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1.9 SPECIFICATION SUMMARY

Table 1-3 summarizes the specifications of the Series 656.

Table 1-3. Series 656 Specifications (Page 1 of 2)

Operation:	Menu-driven with accessible "HELP" screens
Dimensions:	
Package:	Rugged, portable case with multiposition handle
Size:	6" high by 19" wide by 21" deep (Approx. 15 by 48 by 53 centimeters)
Weight:	45 lbs (Approximately 20.25 kg)
Environmental Specs:	
Operating:	10° to 40°C (50° to 104°F)
Storage:	-20° to 55°C (-4° to 131°F)
Humidity:	10% to 90% (non-condensing)
Time Clock:	Crystal-controlled, ±25 PPM stability, 10mS resolution. Lists time in HH:MM:SS:ss format and date in MM:DD:YY format including day of week. (Accurate to within 2 seconds per day.)
Standard Inputs:	Four 2-wire differential Main channel inputs
AC Voltage Ranges:	0 to 580 V rms or 0 to 58 V rms (selectable)
Frequency:	45 to 65 Hz
Sampling Rate:	7.2 kHz
Accuracy:	±1% reading ±0.2% full scale
Resolution:	1V or 0.1V
Impulse Voltage Ranges:	24 to 6144 V pk
Duration:	Longer than 1 uSec
Sampling Rate:	1.8432 MHz
Accuracy:	±10% reading ±1% full scale
Resolution:	12V at and below 1536 V, 24V above 1536 V

(cont'd)

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Table 1-3. Series 656 Specifications (Page 2 of 2)

Optional Inputs:	Eight 2-wire multimode scalable, fully differentiable input channels
DC Voltage Ranges:	0 to 10 V dc (standard); 4 to 20 mA dc (optional)
Sampling Rate:	12 Hz
Accuracy:	±0.5% reading ±0.2% full scale
Memory:	512K-bytes of non-volatile RAM; 128K-bytes of program RAM; 64K-bytes of system RAM; 64K-bytes of system ROM
Disk Drives:	Dual 3-1/2 inch, compatible with double sided/double density microfloppy diskettes
Printer:	High-resolution graphics, 256 dots/line, automatic paper take-up included
Paper:	Thermal, 256 dots per line
User Interfaces:	
Screen:	5-inch (measured diagonally) monochrome CRT with touch-sensitive overlay
Keyboard:	Full-travel, typewriter style, alphanumeric
Serial Ports:	One 9-pin RS-232C port (9600 baud) One 25-pin RS-232C port (1200 baud)
Power Requirements:	90 to 250 V rms, 50 to 60 Hz, 100 watts typical
Uninterruptable Power Supply (UPS):	Standard. Provides period of uninterrupted operation in the event of power outage. Six to ten hours on typical recharge.

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1.10 STANDARD ACCESSORIES

Part #	Quantity	Description
TM-112775 Vol. 1	1	Series 656 Operator's Manual
110888	1	Roll of Thermal Printer Paper
110893-G1	1	Shielded AC Line Cord

1.11 OPTIONAL ACCESSORIES

See step (3) in Subsection 1.12 for information on how to obtain the Volume 2 (Service/Maintenance) manual listed below.

Part #	Quantity Required	Description
TM-112275 Vol. 2	1	Series 656 Service/ Maintenance Manual
113445-G1	1	RS-232C Main Port Cable (DCE-to-DTE)
113446-G1	1	RS-232C Null-Modem Cable (DCE-to-DCE)
113447-G1	1	RS-232C Auxiliary Port Cable
656-PA-1001	1	Sensor Channel Board (8-Channel Transducer)
112931-G1	1-4	Main Channel Input Cables
113070	?	Box of 10 microfloppy diskettes

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1.12 FACTORY REPAIR

When factory repair is required, proceed as follows:

(1) Contact Dranetz Service Corp. (formerly Dranetz Technologies, Inc., Customer Service Dept.) in order to obtain an authorization number for factory repair.

Telephone No: (201) 755-7081
Telex: 499-7808
TWX: (710) 997-9553
FAX: (201) 287-8627
Cable: DRANETZ

(2) Fill out the REPAIR/SERVICE ORDER form enclosed in this manual and ship it along with the malfunctioning equipment to Dranetz Service Corp. If this form is not enclosed, contact Dranetz Service Corp. for a replacement form.

(3) You have been supplied a Control Form with a Registration Number in this Operating Manual. The purpose of this form is to allow you to obtain a Volume 2 manual (Service/Maintenance manual) for your unit. If this form is not enclosed, contact Dranetz Service Corp. for a replacement.

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DRANETZ SERVICE CORPORATION
Subsidiary of Dranetz Technologies, Inc.
2259 SO. CLINTON AVE., **BLDG. 1**
SOUTH PLAINFIELD, NJ 07080

TEL. (201) 755-7081
TWX: (710) 997-9553
TELEX: 499-7808
CABLE: DRANETZ

REPAIR/SERVICE ORDER

NOTE: THIS COMPLETED FORM MUST ACCOMPANY RETURNED EQUIPMENT

CUSTOMER SHIPPING & BILLING INFORMATION

CUSTOMER P.O. # _____ P.O. DATE _____

SHIP TO: _____ INVOICE TO: _____

In Continental U.S., material will be returned by Dranetz to you by UPS, UPS Blue or other carrier chosen by Dranetz unless otherwise designated.

EQUIPMENT BEING RETURNED

Date of Original Purchase: _____ Original P.O. # _____

Model No. _____ S/N _____

Model No. _____ S/N _____

Ancillary equipment also being returned (If you neglect this, these items may not be returned to you).

☐ Power & Other Cables _____ ☐ Instr. Book _____

☐ Plug-ins (incl. S/N) _____ ☐ Connectors _____

☐ Other _____

RETURN AUTHORIZATION

Have you discussed the problem with Dranetz Sales or Service personnel?

Dranetz Return Authorization # _____

By: _____

If so, with whom _____ Date: _____

Whom should the Dranetz Service Corporation contact for technical questions?

_____ ( ) _____

NAME (Print) DEPARTMENT TELEPHONE

DESCRIPTION OF PROBLEM

Reason for return: Defective ☐ Calibration ☐

Please be detailed, explicit and complete. Include test data, if this helps to describe the problem.
IMPORTANT: Repairs cannot be made unless this section is completely filled out.
(Attach added sheets if necessary)

_____

_____

_____

_____

CHECK WHERE APPLICABLE: IS MALFUNCTION RELATED TO: Warmup ☐ Temperature ☐
Intermittency ☐ Mechanical Handling ☐ Visual Defects ☐ Grounding ☐ Test Data Attached ☐

INITIATOR OF THIS ORDER

_____

NAME/TITLE SIGNATURE TELEPHONE

(SEE OTHER SIDE FOR INSTRUCTIONS)

IMPORTANT (SEE OTHER SIDE FOR INSTRUCTIONS)

IMPORTANT (ENCLOSE THIS ENTIRE FORM WITH EQUIPMENT)

IMPORTANT: FOLLOW INSTRUCTIONS & USE THIS FORM. IT IS DESIGNED TO HELP US HELP YOU.

1. **Before** returning equipment to our factory, call our Service Corporation **Tel: (201) 755-7081**
   Give the model No., serial number, and information on the problem.

   A. Our specialists may be able to solve your problem rapidly without equipment return.

   B. If equipment return is needed, you will be supplied with appropriate instructions and authorization information to expedite service.

2. If return is to be made,

   A. Fill out the other side of this form **COMPLETELY.**

   B. Enclose original of form INSIDE the shipping carton, preferably attached by masking tape to the equipment.

   C. Ship prepaid (including insurance); we will return prepaid unless otherwise advised by you.

   D. **IMPORTANT** - PACK PROPERLY! SHIPPING DAMAGE WILL BE CHARGED TO YOU!

NOTE:

Statement of Warranty - All products of Dranetz Technologies, Inc. are warranted to the original purchaser against defective material and workmanship for a period of one year from the date of delivery. Dranetz will repair or replace, at its option, all defective equipment returned, freight prepaid, during the warranty period, without charge for repair, provided there is no evidence that the equipment has been mishandled or abused.

FILL OUT OPPOSITE SIDE OF THIS FORM AND RETURN WITH EQUIPMENT.

SECTION II
INSTALLATION AND OPERATION

2.1 GENERAL

This section contains the installation, setup, and operating instructions for the Series 656 Disturbance Waveform Analyzer.

2.2 UNPACKING

Carefully open the upper end of the shipping container and remove its contents. DO NOT discard the shipping container and packaging materials until after inspecting the Series 656 for any shipping damage. Any damage caused by shipping and handling should be immediately reported to the carrier.

In the event that any physical damage does exist, use the original packing case and materials to return the Series 656 to Dranetz Service Corp. This should be done, however, only after an insurance claim has been filed with your underwriter or carrier, or both. Also, before returning any equipment to Dranetz Service Corp., obtain a return authorization number by calling Dranetz Service Corp. (see the REPAIR/SERVICE ORDER form enclosed in this manual).

CAUTION

If your disk drives contained a protective insert card when you first unpacked the unit, DO NOT throw away these cards. To protect the heads of the disk drives in your unit, you MUST insert these cards whenever you transport the unit. If your disk drives did not contain protective insert cards, you have a disk drive setup that does not require protective insert cards. (Refer to Appendix C for a picture of these two disk drive setups.)

2.3 INSTALLATION WARNINGS

WARNING

Be sure that the Series 656 is off before proceeding with any installation.

Because of possible shock or fire hazards, connection of this unit should be performed in compliance with the National Electric Code (ANSI C1) and/or any other requirements which are applicable to the user. Installation, operation, and maintenance should be performed ONLY by qualified personnel. Qualifications for performing such procedures should be self-determined.

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2.4 SETTING UP THE SERIES 656

Initial setup of the Series 656 involves standing it up, opening the keyboard, making RS-232C connections (if any), wiring the Main channel inputs, wiring the optional Sensor (transducer) channel inputs (if any), and applying power.

2.4.1 Moving the Four-Position Handle/Stand

(1) Place the Series 656 on its rubber feet with its handle facing forward on a flat surface.

(2) With both hands, press in the two outside knobs on the handle/stand releasing it from its locked position.

(3) Raise the front of the Series 656 to one of the three standing positions on its handle/stand.

2.4.2 Uncovering the Keyboard

(1) Face front of the Series 656.

(2) Insert the key in the case panel and turn it one-quarter turn counterclockwise; remove the key.

(3) Gently fold down the keyboard until it comes to rest on the flat surface.

NOTE

When operating the Series 656 in a "dirty" environment, leave the keyboard closed when you are not using the printer, screen, or keyboard. This protects the inside of the unit from dust and other contaminants.

2.4.3 Connecting the RS-232C Cables (Optional)

The next two subsections provide information on connecting RS-232C cables to the Main and Auxiliary Ports. Subsection 2.4.3.1 is applicable if you are using a modem, personal computer, or other I/O device to operate the Series 656; Subsection 2.4.3.2 is applicable if you are using a remote printer.

2.4.3.1 Main Port-to-I/O Device Connection

The Series 656 uses no hardware or software handshaking on its Main Port, therefore, the I/O device should not require handshaking. The Series 656's Main Port is configured as a DCE device. It can be directly connected using a "straight through" cable to any equipment configured as a DTE (see Table 1-1 and Figure 1-4). If the equipment is configured as a DCE, you'll need a Null-Modem Cable to make this connection (see Figure 1-5). The Null-Modem Cable allows the connection of two DCE devices.

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(1) Plug one end of the Main Port Cable (P/N 113445-G1) into the Series 656 Main Port (DCE) connector; plug the other end of the cable into the I/O device's DTE connector, using a gender changer adapter cable if necessary. Note: If the I/O device has a DCE connector, use the Null-Modem Cable, P/N 113446-G1 (see Figure 1-5).

(2) Secure both ends with retaining screws.

2.4.3.2 Auxiliary Port-to-Printer Connection

(1) Plug the 9-pin end of the Auxiliary Port Cable (P/N 113447-G1) into the Series 656 Auxiliary Port (DCE) connector; plug the 25-pin end of the cable into the printer's DTE connector, using a gender changer cable if necessary.

(2) Secure both ends with retaining screws.

2.4.4 Connecting the Power Cord

Plug the female end of the power cord into the Series 656 rear panel receptacle; plug the male end into an appropriate ac power source.

2.4.5 Wiring the Main Channels for AC Inputs

WARNING

Connection should be performed ONLY by qualified personnel, whose qualifications are self-determined. Conductors connecting to measurement points should be approved for the specific use. When connecting to branch circuits of 20 amperes or less, the minimum flexible cord size is No. 18 (1mm square). For branch circuits with higher ampacity, refer to the National Electric Code, ANSI CI-1975, Paragraphs 2404-4 and 250-95. Refer to Article 250 of the above reference if in doubt. Outside of the United States, consult applicable safety standards.

The Series 656 has four Main channel inputs. Each input consists of a barrier type terminal strip located under a safety cover. To wire each of the Main channel inputs, proceed as follows:

(1) Turn off the Series 656 and disconnect its power cord.

(2) Turn off the power to the line(s) that will be monitored.

(3) Remove the safety cover of the barrier strip you are going to wire. (Only remove the one you will be currently working on.)

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(4) Read the circuit connection guidelines and circuit applications in Subsections 2.4.5.1 and 2.4.5.2 before continuing.

(5) Connect a line to the three terminal inputs. Connection is as illustrated in Figure 2-1 below:

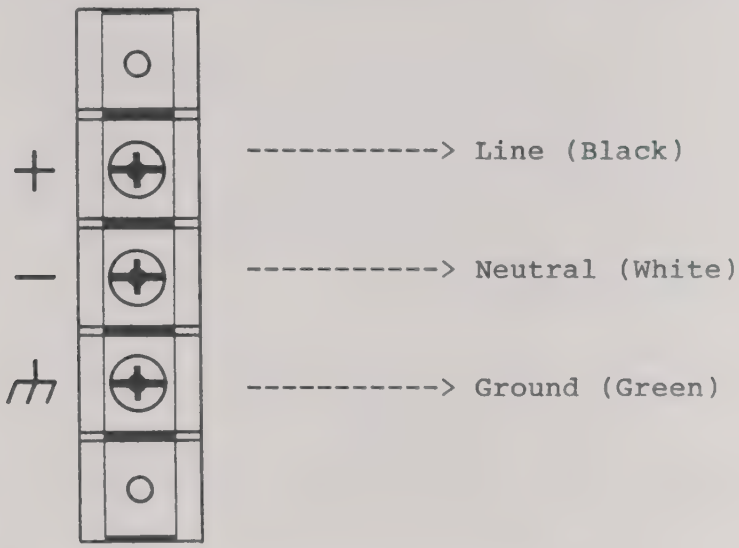

Figure 2-1. Main Channel Wiring

(6) Replace the safety cover of the barrier strip you have just wired.

(7) If you are wiring more than one channel, repeat steps 3 through 6 for each additional channel.

CAUTION

To avoid damaging the Series 656, DO NOT apply voltages exceeding 600 V rms to its inputs.

(8) After verifying that all safety covers are in place, reapply power to the line(s) that will be monitored.

2.4.5.1 Circuit Connection Guidelines for the Main Channels

Proper monitoring and analysis of ac and dc voltage disturbances requires careful attention to the method of connection between the Series 656 Main channels and the monitored circuits. To obtain the most accurate and relevant voltage monitoring data, the following guidelines are suggested:

a. Be aware that frequency information is primarily measured on channel A; if channel A fails, it's then measured on channel B; if channel B fails, it's then measured on channel C. Never connect channel A from Neutral-to-Ground.

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b. As a convention, always connect channel D from Neutral-to-Ground (unless you are monitoring dc inputs).

c. The ground (Gnd) input only acts as a common grounding point and is internally tied to the Series 656 frame ground--which is connected to the line cord earth ground. Be careful not to inadvertently contaminate a "clean" ground with a "dirty" building ground through this path. To avoid this, connect the Series 656's power to the line being monitored.

d. To minimize spurious impulse transients and interchannel coupling, always use Dranetz Main channel connector cables, P/N 112931-G1.

e. Test cable length should be minimized, preferably eight feet or less, from the Main channel to the circuit connection point. This minimizes the amplitude variation of impulse transients.

f. If you are monitoring a power line connected to critical, sensitive load equipment, the test cable should be connected to the power line as close a possible to the load. For three-phase loads, the Series 656 should be connected in the same way as the load equipment, for example, Line-to-Line or Line-to-Neutral.

2.4.5.2 Circuit Applications for the Main Channels

a. The Series 656 can be used to monitor Neutral-to-Ground and Line-to-Neutral voltage in a 120V ac single-phase system (see Figure 2-2). This application would use two of the four Main channels (A and D in the illustration).

b. The Series 656 can be used to monitor Line A-to-Neutral, Line B-to-Neutral, and Neutral-to-Ground voltages in a 120V ac split-phase system, while also monitoring Line A-to-Line B voltage in a 240V ac split-phase system (see Figure 2-3). This application would use all four Main channels.

c. The Series 656 can be used to monitor Line A-to-Line B, Line B-to-Line C, and Line A-to-Line C voltages in a three-phase "delta" system (see Figure 2-4). This application would use three of the four Main channels (A, B, and C in the illustration).

d. The Series 656 can be used to monitor Line A-to-Neutral, Line B-to-Neutral, Line C-to-Neutral, and Neutral-to-Ground voltages in a three-phase "wye" system (see Figure 2-5). This application would use all four Main channels.

e. The Series 656 can be used to monitor up to three dc inputs using Main channels B, C, and D. For this configuration, Main channel A should be set up to monitor Line A-to-Neutral voltage (see Figure 2-6).

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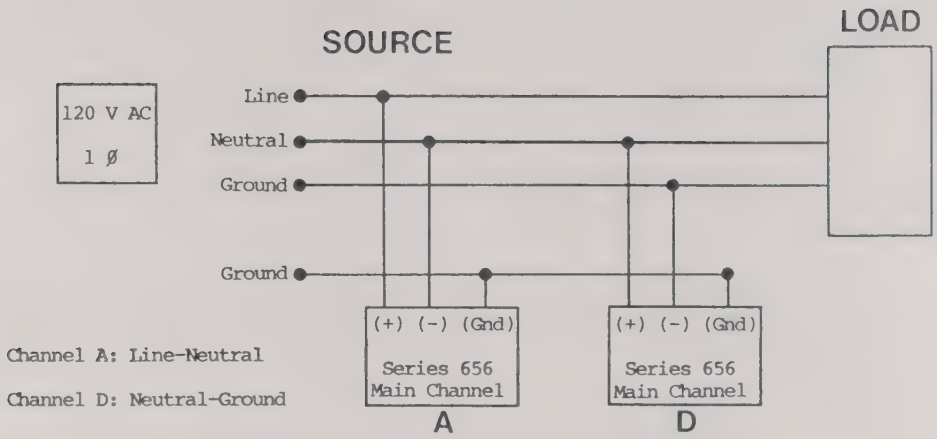

Figure 2-2. 120V AC Single-Phase Connections

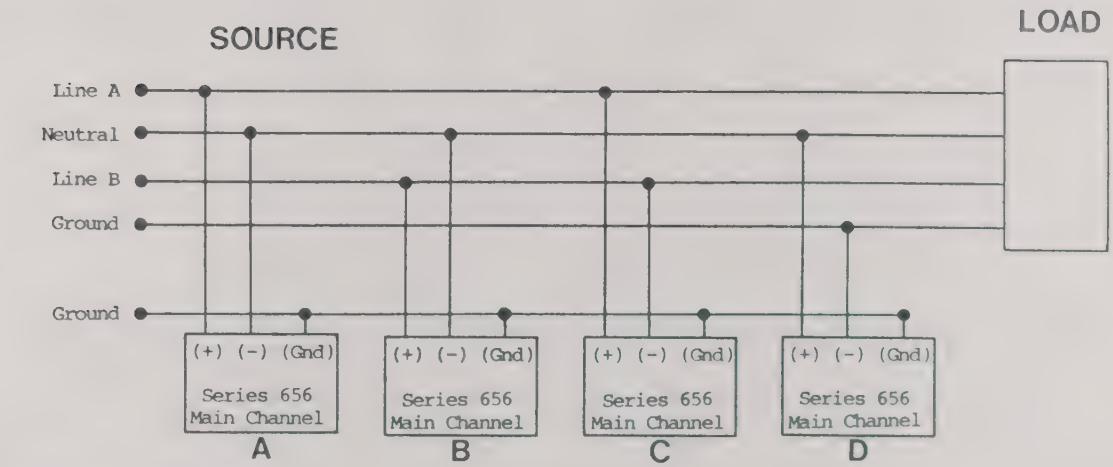

Figure 2-3. 120V/240V AC Split-Phase Connections

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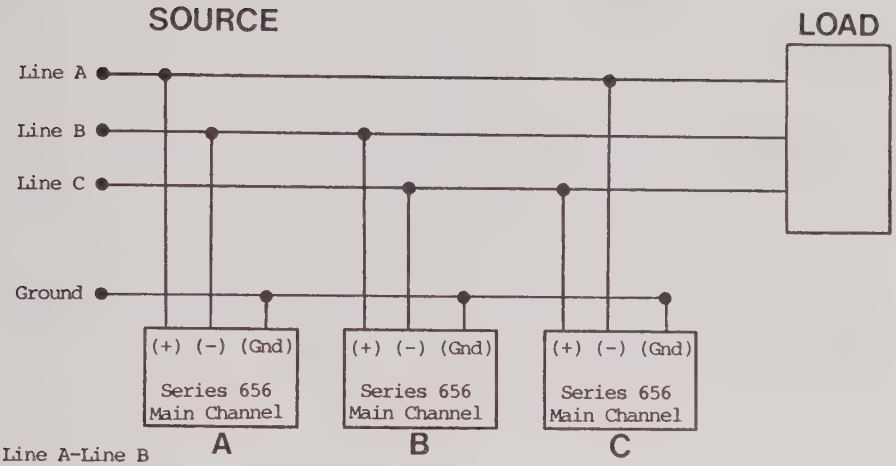
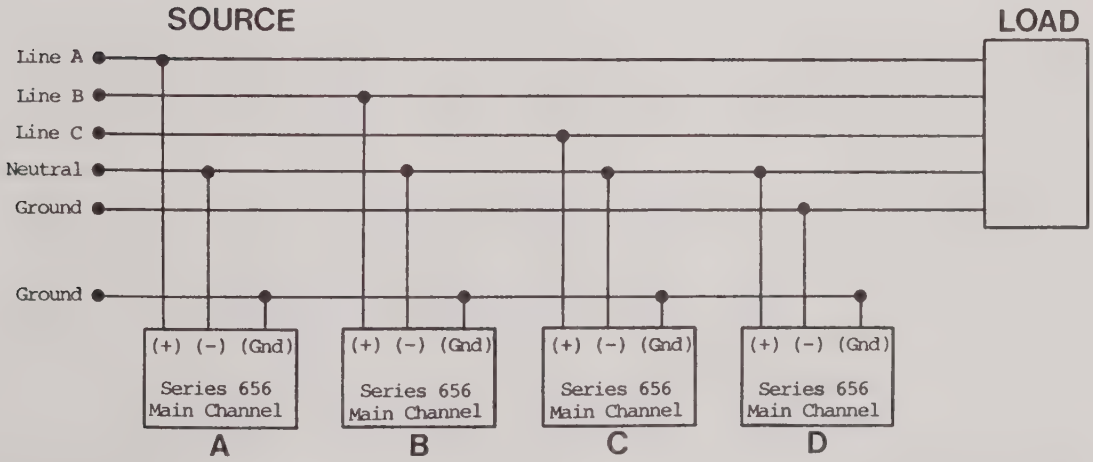


Channel A: Line A-Line B

Channel B: Line B-Line C

Channel C: Line C-Line A

Figure 2-4. Three-Phase "Delta" Connections



Channel A: Line A-Neutral

Channel B: Line B-Neutral

Channel C: Line C-Neutral

Channel D: Neutral-Ground

Figure 2-5. Three-Phase "Wye" Connections

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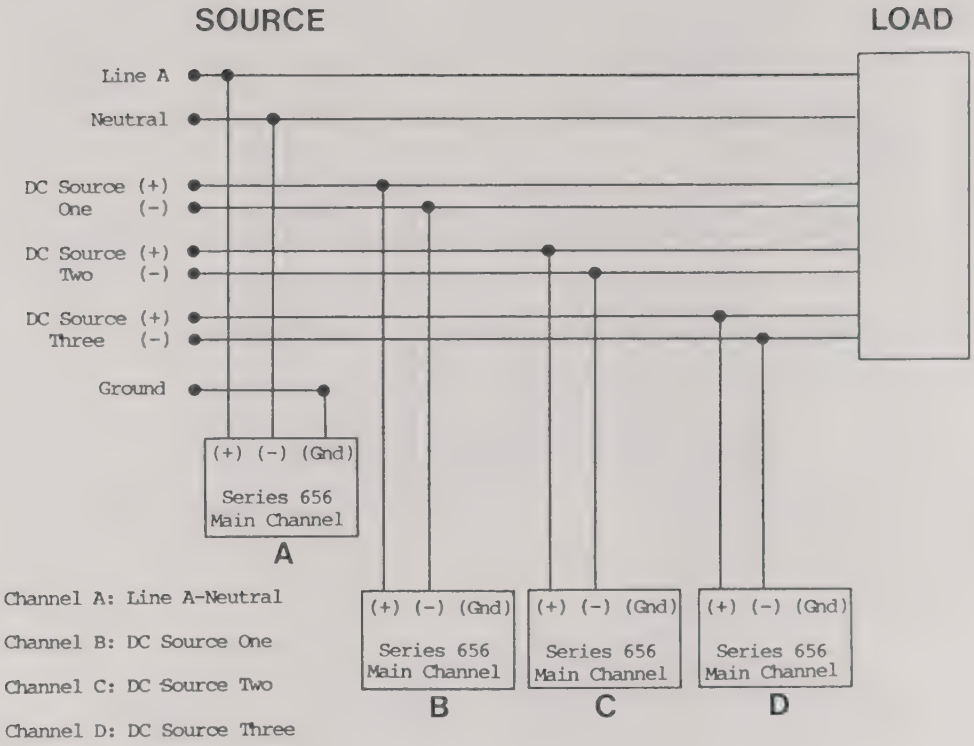

Figure 2-6. Typical 3-Source DC Input Connections

Below is a suggested example of a Main Channel Setups Screen that corresponds to the above configuration (note that the range is set "Hi" for channel A and "Lo" for channels B, C, and D):

```
                Main Channel Setups
1 Setup #16      A     B     C     D
2 Channels      On    On    On    On
3 Range         Hi    Lo    Lo    Lo
4 Impulse     1000  0100  0050  0200
5 Voltage      100  02.0  05.0  10.0
6 Frequency    0.5  (All Channels)
7 Descrip.  Typical 3-Source DC Configuration.
(A)ctivate (P)rint e(X)it (H)elp
```

NOTE

Series 656 voltage thresholds are set for ac rms changes. For dc changes, you must remove the rms factor of ($\sqrt{2}$). You must take the dc voltage setting you want, divide it by 1.414, and set it equal to the nearest integer value in the Main Channel Setups. For example: If you want 7V dc as the trip point, set the threshold to 7/1.414 = 5 (as in Channel C above).

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2.4.6 Wiring the Sensor (Transducer) Channel Inputs

WARNING

Connection should be performed ONLY by qualified personnel, whose qualifications are self-determined. Conductors connecting to measurement points should be approved for the specific use. When connecting to branch circuits of 20 amperes or less, the minimum flexible cord size is No. 18 (1mm square). For branch circuits with higher ampacity, refer to the National Electric Code, ANSI CI-1975, Paragraphs 2404-4 and 250-95. Refer to Article 250 of the above reference if in doubt. Outside of the United States, consult applicable safety standards.

The Sensor (transducer) channel assembly for the Series 656 has eight paired input channels. Each channel consists of two positions, "+" and "-", on the 16-position removable terminal strip. To wire each of the channels, proceed as follows:

(1) Turn off the Series 656 and disconnect its power cord.

(2) Turn off the power to the transducer(s) that will be monitored and any other transducers currently wired to the Sensor (transducer) channel input.

(3) Pull the Sensor (transducer) channel barrier strip straight out from its housing.

(4) Read the circuit connection guidelines and circuit applications in Subsections 2.4.6.1 and 2.4.6.2 before continuing.

(5) Identify the proper channel position on the terminal block and wire the transducer as shown in Figure 2-7. Pay close attention to be sure the "+" and "-" terminals are connected to the transducer's "+" and "-" leads, respectively.

(6) Repeat step 5 for each channel you are wiring.

(7) When you have wired all of the channels, re-insert the barrier strip into its housing.

(8) Verify that all connections have been made--check for proper polarity--and that the barrier strip is securely in place.

(9) Re-connect the power cord and reapply power to the Series 656 and the transducers being monitored.

CAUTION

To avoid damaging the Sensor (transducer) channel inputs, DO NOT exceed the rated inputs on any channel. These are the +10V, +40mA differential, or ±50V common mode.

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CAUTION

Connect a supplied jumper between the "+" and "-" terminals of each channel that's not being used. Also, for any channels used, make sure the "+" and "-" terminals are connected to the transducer's "+" and "-" leads.

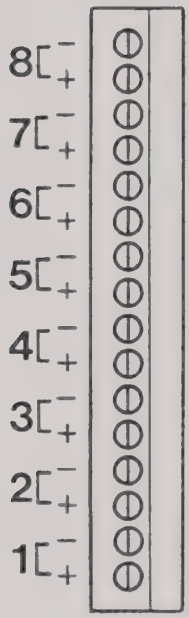

Figure 2-7. Sensor (Transducer) Channel Wiring

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2.4.6.1 Circuit Connection Guidelines for Sensor (Transducer) Channel Inputs

When monitoring and analyzing transducer voltages and currents, pay close attention to the connection between the Sensor (transducer) channel input and the monitored transducer. Also, pay attention to the following guidelines:

a. When using current type transducers, such as 4 to 20 mA, be sure to observe the loop resistance ratings of the transducer. The Sensor (transducer) channel input assembly has a maximum loop resistance of 250 ohms.

b. To minimize noise on the input lines, shielded cable or twisted pair wire is recommended.

c. When using shielded cable, be sure to terminate the shield at one end only, preferably to the frame ground provided on the Series 656 Mainframe.

d. Always minimize cable lengths when making connections to reduce amplitude variations in the input signal.

e. Although the Sensor (transducer) channel input is designed to operate in common mode environments of up to $\pm$50V, you should try to minimize this voltage to ensure a more accurate and reliable reading.

2.4.6.2 Circuit Applications for Sensor (Transducer) Channel Inputs

The Sensor (transducer) channels provide monitoring and analysis for up to eight environmental sensors, or any other type of sensor (such as a temperature probe) with an output in the 0 to 10V or 0 to 20mA range.

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2.5 BEGINNING OPERATION USING THE SERIES 656*

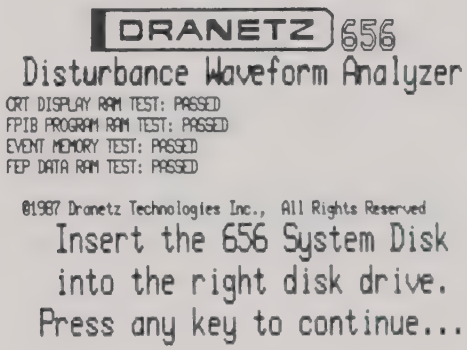
At this point, it is assumed the Series 656 has been properly connected and is ready for operation. Before continuing, read Section III in this manual.

Operation of the unit, including setup parameters, is performed through a system of self-prompting menus and screens which are discussed in the subsections below. The current time, date, and day of week are displayed at the bottom of most screens.

2.5.1 Initial Start-Up

Turn the SETUP knob on the front panel to the setup number you want the Series 656 to begin monitoring when it's first turned on. This is the only purpose of this knob. Once the unit is on, you can only change setups through the Main Channel Setup Screens.

Turn on the Series 656. The unit will automatically perform a diagnostics self-test, checking out the integrity of its various subsystems. If all tests are passed, the Start-Up Screen will appear as follows:


DRANETZ 656
Disturbance Waveform Analyzer
CRT DISPLAY RAM TEST: PASSED
FPIB PROGRAM RAM TEST: PASSED
EVENT MEMORY TEST: PASSED
FEP DATA RAM TEST: PASSED
©1987 Dranetz Technologies Inc., All Rights Reserved
Insert the 656 System Disk
into the right disk drive.
Press any key to continue...

In an actual display, the version number of the system ROMs will appear in the upper left-hand corner. Any malfunctions detected are listed. (See Section III for further instructions if this occurs.)

---

* If you are installing the Series 656 for the first time, or if the unit has been stored for an extended period of time, plug it in and turn it on. You must allow the Series 656 internal UPS batteries to charge for 24 hours before operating the unit.

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2.5.1.1 Start-Up Screen

The Start-Up Screen prompts you to insert the Series 656 System disk into the right-hand disk drive and to press any key to continue.

2.6 OPERATING THE SERIES 656

Insert the Series 656 System Disk into the right-hand drive and press any key. The program will take about 25 seconds to load. After the program is loaded, the Series 656 Status Screen will appear.

2.6.1 Example Status Screen

```
Status as of 07/09/87 @ 10:08:05
 * * * Monitoring is On * * *
Ch.A   Ch.B   Ch.C   Ch.D   Freq
 On     Off    Off    Off   60.0
Sensor Channels Used: None
Memory: 320 Events (31% Full)
Active Setup: 2  Knob Psn.: 2
Last Event: 07/09/87 @ 10:07:53
Press any key for the MAIN MENU
```

The above Status Screen indicates the following:

- monitoring is on,
- channel A is on and channels B, C, and D are off,
- the current frequency of the Synchronization channel is 60 Hz,
- no Sensor (transducer) channels are being used,
- 320 events are in memory and memory is 31% full,
- the currently active setup is 2,
- the SETUP knob is set to position "2", and
- the last event occurred on July 9, 1987 at 10:07:53

2.7 SERIES 656 MENU STRUCTURE

Figure 2-8 on the following page illustrates the Series 656 menu structure. All commands and operations are performed through these menus. Subsections 2.8 through 2.8.6.2 describe these commands and operations.

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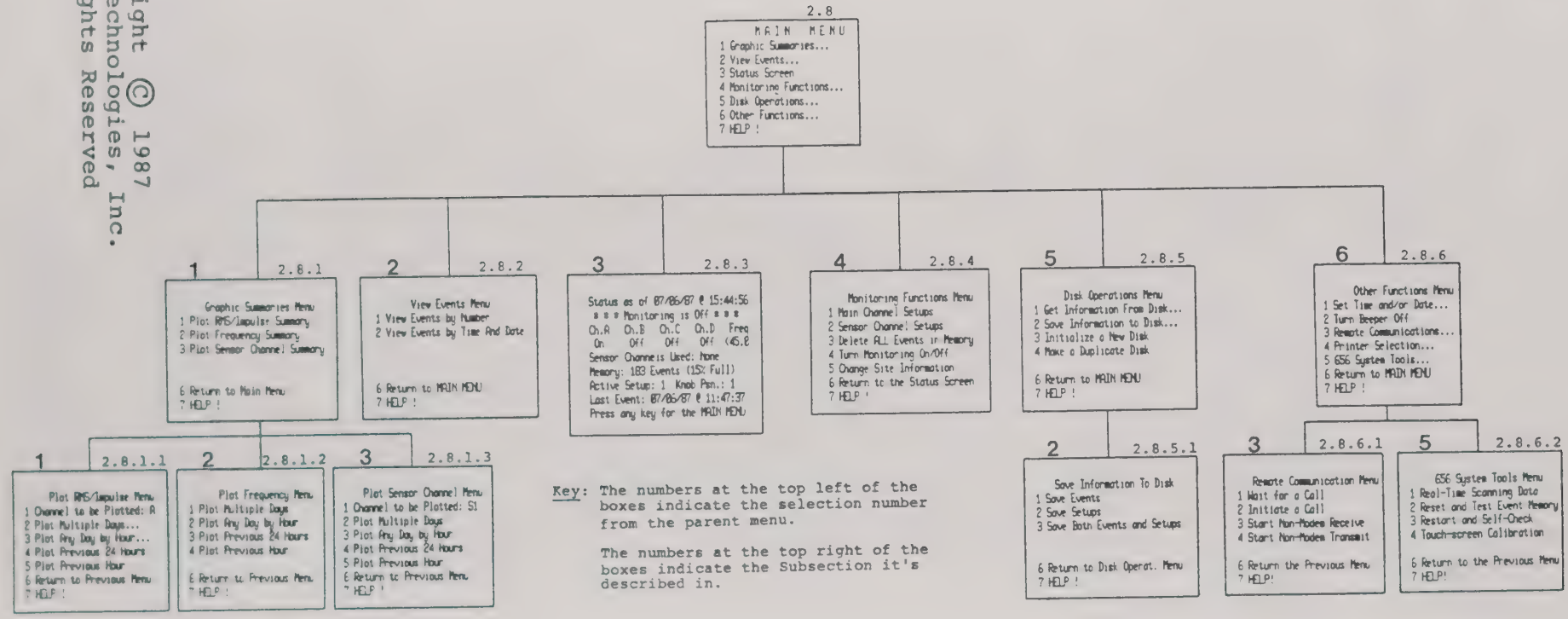

Figure 2-8. Series 656 Menu Structure

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2.8 MAIN MENU

The Main Menu is the top menu in the Series 656 menu structure:

MAIN MENU
1 Graphic Summaries...
2 View Events...
3 Status Screen
4 Monitoring Functions...
5 Disk Operations...
6 Other Functions...
7 HELP !

From the Main Menu you can work your way down to any menu or Setup Screen in the structure.

Possible Selections and What They Mean

Selection: **1 Graphic Summaries**

Application: Selection 1 puts you in the Graphic Summaries Menu where you can plot RMS, impulse, and frequency summaries. Summaries can be plotted in multiple days, specific hours, previous 24 hours, or previous hour. Summaries can be graphical illustrations, text descriptions, or both.

Described in: 2.8.1

Selection: **2 View Events**

Application: Selection 2 puts you in the View Events Menu where you can view events according to their sequential number in memory, or according to their time and date of occurrence.

Described in: 2.8.2

Selection: **3 Status Screen**

Application: Selection 3 brings up the Status Screen. The Status Screen indicates the monitoring status, Main channel statuses, Synchronization channel frequency, Sensor (transducer) channel status, number of events in memory, percentage of memory used, currently active setup, SETUP knob position, and the time and date of the last event recorded.

Described in: 2.8.3

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Selection: **4 Monitoring Functions**

Application: Selection 4 puts you in the Monitoring Functions Menu where you can view the 16 Main channel setups, view the 8 Sensor (transducer) channel setups, delete all events in memory, turn monitoring on and off, and change site descriptions.

Described in: 2.8.4

Selection: **5 Disk Operations**

Application: Selection 5 puts you in the Disk Operations Menu where you can load stored disk information to the Series 656, save recorded Series 656 information to a disk, initialize a new disk, and create a duplicate disk.

Described in: 2.8.5

Selection: **6 Other Functions**

Application: Selection 6 puts you in the Other Functions Menu where you can set the internal clock's time and date, turn the beeper on and off, access remote communications, change the active printer, access the Series 656 system tools (to test memory, calibrate the touch-screen, and restore factory preset values for the setups).

Described in: 2.8.6

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 6.

2.8.1 Graphic Summaries Menu

Selection 1 in the Main Menu will put you in the Graphic Summaries Menu:

Graphic Summaries Menu
1 Plot RMS/Impulse Summary
2 Plot Frequency Summary
3 Plot Sensor Channel Summary

6 Return to Main Menu
7 HELP !

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Possible Selections and What They Mean

Selection: **1 Plot RMS/Impulse Summary**

Application: Refer to Subsection 2.8.1.1

Selection: **2 Plot Frequency Summary**

Application: Refer to Subsection 2.8.1.2

Selection: **3 Plot Sensor Channel Summary**

Application: Refer to Subsection 2.8.1.3

Selection: **6 Return to Main Menu**

Application: Selection 6 returns you to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 3.

2.8.1.1 Plot RMS/Impulse Summary Menu

Selection 1 in the Graphic Summaries Menu will put you in the Plot RMS/Impulse Menu:

Plot RMS/Impulse Menu
1 Channel to be Plotted: A
2 Plot Multiple Days...
3 Plot Any Day by Hour...
4 Plot Previous 24 Hours
5 Plot Previous Hour
6 Return to Previous Menu
7 HELP !

Possible Selections and What They Mean

Selection: **1 Channel to be Plotted**

Application: Selection 1 alternates the channel to be plotted from A through D. Each of the possible 16 setups contains programming for channels A through D.

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Selection: **2 Plot Multiple Days**

Application: Selection 2 will immediately prompt you for a start date for the multiple days plot:

Start Date mm/dd/yy =>

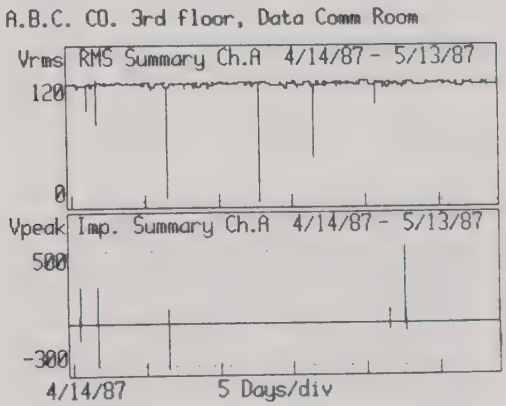
You can either enter a start date or press [RETURN] to take the date of the first event in memory.

You are then prompted with an end date for the plot:

End Date mm/dd/yy =>

You can either enter an end date or press [RETURN] to take the date of the last event in memory.

You are then prompted to press [RETURN] to execute the plot, and a display such as the following appears:



You can then press [P] to print this display or press [T] to get a text description of it (top of next page).

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```
Ch. A RMS/Impulse Plot Summary
A.B.C. CO. 3rd floor, Data Comm Room
Start on Event # 1      End on Event # 329
     Start Time:  4/14/87  17:10
     End Time:    5/13/87  23:59
Worst RMS Events
Max Value = 123.1 Vrms  Event # 50
Min Value = 0.0 Vrms    Event # 142
# Impulse Events = 8
Worst Pos Value = 528 Vpeak   Event # 278
Worst Neg Value = -324 Vpeak  Event # 88
```

The above text indicates the site description, the starting and ending event numbers and their time and date, the maximum and minimum RMS event values and their time and date, the number of impulse events recorded, and the event number and value of the worst positive and negative impulse events.

Selection: **3 Plot Any Day by Hour**

Application: Selection 3 will immediately prompt you for the plot date:

```
Plot Date  mm/dd/yy =>
```

If you press [RETURN], the current day is used as the plot date.

You are then prompted with a start hour:

```
Start Hour (0 to 23) =>
```

If you press [RETURN], the hour of the first event since midnight is taken as the default.

You are then prompted with an end hour:

```
End Hour (1 to 24)
```

If you press [RETURN], the hour of the last event before midnight of the next day is taken as the default.

You are then prompted to press [RETURN] to execute the plot and a display such as the following appears (top of next page).

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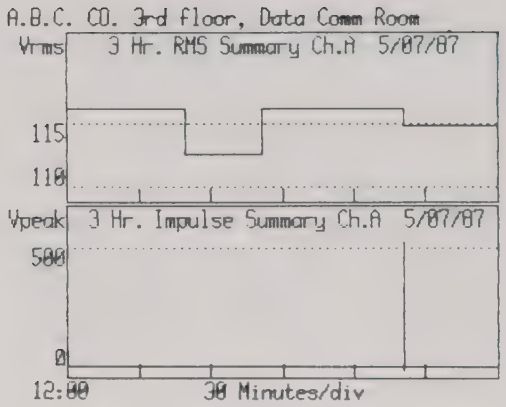

You can then press [P] to print this display or press [T] to get a text description of it:

Ch. A RMS/Impulse Plot Summary

A.B.C. CO. 3rd floor, Data Comm Room

Start on Event # 271 End on Event # 279
Start Time: 5/07/87 12:00
End Time: 5/07/87 15:00

Worst RMS Events
Max Value = 116.3 Vrms Event # 271
Min Value = 112.6 Vrms Event # 274

Impulse Events = 2
Worst Pos Value = 528 Vpeak Event # 278
Worst Neg Value = -12 Vpeak Event # 278

The above text indicates the site description, the starting and ending event numbers and their time and date, the maximum and minimum RMS event values and their time and date, the number of impulse events recorded, and the event number and value of the worst positive and negative impulse events.

Selection: **4 Plot Previous 24 Hours**

Application: Selection 4 will immediately plot the previous 24 hours. You can then press [P] to print this display or press [T] to get a text description of it.

The plot is similar to the one in Selection 3 and is therefore not shown here.

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Selection: **5 Plot Previous Hour**

Application: Selection 5 will immediately plot the previous hour. You can then press [P] to print this display or press [T] to get a text description of it.

The plot is similar to the one in selection 3 and is therefore not shown here.

Selection: **6 Return to Previous Menu**

Application: Selection 6 returns you to the Graphic Summaries Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 5.

2.8.1.2 Plot Frequency Menu

Selection 2 in the Graphic Summaries Menu will put you in the Plot Frequency Menu:

Plot Frequency Menu
1 Plot Multiple Days
2 Plot Any Day by Hour
3 Plot Previous 24 Hours
4 Plot Previous Hour

6 Return to Previous Menu
7 HELP !

Possible Selections and What They Mean

Selection: **1 Plot Multiple Days**

Application: Selection 1 will immediately prompt you for a start date for the multiple days plot:

Start Date mm/dd/yy =>

You can either enter a start date or press [RETURN] to take the date of the first event in memory.

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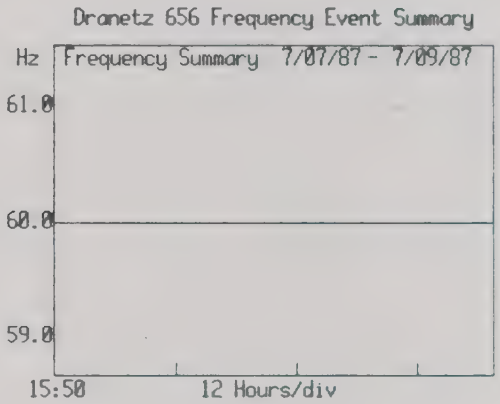
You are then prompted with an end date for the plot:

End Date mm/dd/yy =>

You can either enter an end date or press [RETURN] to take the date of the last event in memory.

You are then prompted to press [RETURN] to execute the plot and a display such as the following appears:

Note:
The frequency remained constant at 60.0 Hz throughout this period.



You can then press [P] to print this display. Note: Text descriptions are not applicable for frequency plots.

Selection: **2 Plot Any Day by Hour**

Application: Selection 2 will immediately prompt you for the plot date:

Plot Date mm/dd/yy =>

If you press [RETURN], the current day is used as the plot date.

You are then prompted with a start hour:

Start Hour (0 to 23) =>

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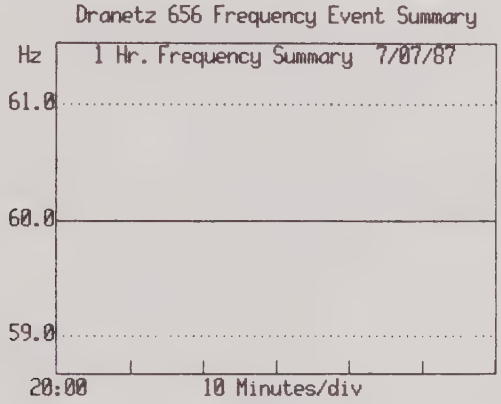
If you press [RETURN], the hour of the first event since midnight is taken as the default.

You are then prompted with an end hour:

End Hour (1 to 24)

If you press [RETURN], the hour of the last event before midnight of the next day is taken as the default.

You are then prompted to press [RETURN] to execute the plot and a display such as the following appears:



You can then press [P] to print this display. Note: Text descriptions are not applicable for frequency plots.

Selection: **3 Plot Previous 24 Hours**

Application: Selection 3 will immediately plot the previous 24 hours. You can then press [P] to print this display. Note: Text descriptions are not applicable for frequency plots.

The plot is similar to the one in selection 2 and is therefore not shown here.

Selection: **4 Plot Previous Hour**

Application: Selection 4 will immediately plot the previous hour. You can then press [P] to print this display. Note: Text descriptions are not applicable for frequency plots.

The plot is similar to the one in selection 2 and is therefore not shown here.

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Selection: **6 Return to Previous Menu**

Application: Selection 6 returns you to the Graphic Summaries Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 4.

2.8.1.3 Plot Sensor Channel Menu

Selection 3 in the Graphic Summaries Menu will put you in the Plot Sensor Channel Menu:

```
Plot Sensor Channel Menu
1 Channel to be Plotted: S1
2 Plot Multiple Days
3 Plot Any Day by Hour
4 Plot Previous 24 Hours
5 Plot Previous Hour
6 Return to Previous Menu
7 HELP !
```

Selection: **1 Channel to be Plotted**

Selection 1 alternates the channel to be plotted from S1 through S8. Each of the possible 16 setups contains programming for channels S1 through S8.

Selection: **2 Plot Multiple Days**

Application: Selection 2 will immediately prompt you for a start date for the multiple days plot:

```
Start Date  mm/dd/yy =>
```

You can either enter a start date or press [RETURN] to take the date of the first event in memory.

You are then prompted with an end date for the plot:

```
End Date  mm/dd/yy =>
```

You can either enter an end date or press [RETURN] to take the date of the last event in memory.

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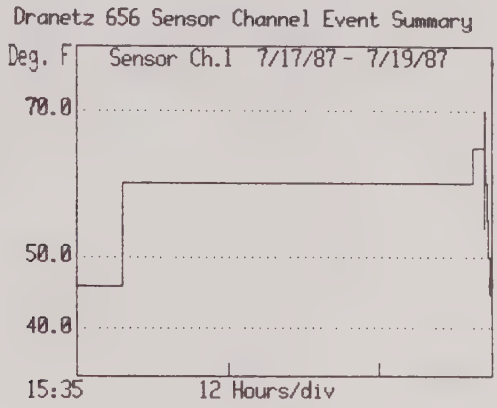
You are then prompted to press [RETURN] to execute the plot and a display such as the following appears:



You can then press [P] to print this display. Note: Text descriptions are not applicable for Sensor channel plots.

Selection: **3 Plot Any Day by Hour**

Application: Selection 3 will immediately prompt you for the plot date:

Plot Date mm/dd/yy =>

If you press [RETURN], the current day is used as the plot date.

You are then prompted with a start hour:

Start Hour (0 to 23) =>

If you press [RETURN], the hour of the first event since midnight is taken as the default.

You are then prompted with an end hour:

End Hour (1 to 24)

If you press [RETURN], the hour of the last event before midnight of the next day is taken as the default.

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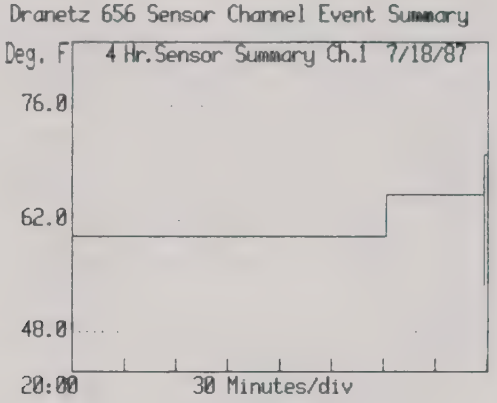
You are then prompted to press [RETURN] to execute the plot and a display such as the following appears:



You can then press [P] to print this display. Note: Text descriptions are not applicable for Sensor channel plots.

Selection: **4 Plot Previous 24 Hours**

Application: Selection 4 will immediately plot the previous 24 hours. You can then press [P] to print this display. Note: Text descriptions are not applicable for Sensor channel plots.

The plot is similar to the one in selection 3 and is therefore not shown here.

Selection: **5 Plot Previous Hour**

Application: Selection 5 will immediately plot the previous hour. You can then press [P] to print this display. Note: Text descriptions are not applicable for frequency plots.

The plot is similar to the one in selection 3 and is therefore not shown here.

Selection: **6 Return to Previous Menu**

Application: Selection 6 returns you to the Graphic Summaries Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 5.

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2.8.2 View Events Menu

Selection 2 in the Main Menu will put you in the View Events Menu:

```
View Events Menu
1 View Events by Number
2 View Events by Time And Date



6 Return to MAIN MENU
7 HELP !
```

Possible Selections and What They Mean

Selection: **1 View Events by Number**

Application: Selection 1 will immediately prompt you with a screen such as the following:

```
To display a stored event, enter
the number followed by [RETURN].

Most recent event is # 332

Enter Event Number =>
```

You can either enter an event number and press [RETURN], or simply press [RETURN] to display the listed event. An event, such as the impulse in Figure 2-9, is displayed:

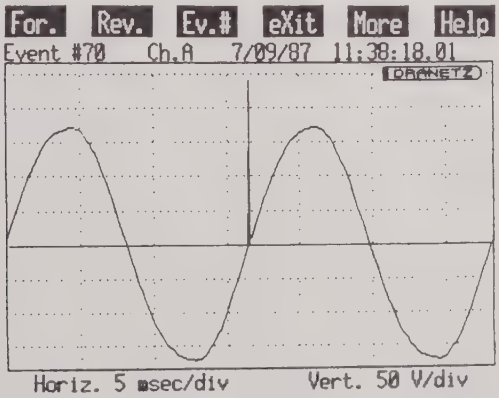

Figure 2-9. Captured Impulse, First Screen

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Text Line Below Screen

Horiz. 5 msec/div -- Each division line as you go from left to right across the screen represents 5 milliseconds.

Vert. 50 V/div -- Each division line as you go from the bottom to the top of the screen represents 50 volts.

Text Line Above Screen

Event #70 -- Indicates this is the 70th event in memory.

Ch.A -- Indicates this is a picture of channel A data.

7/09/87 -- Indicates the date the disturbance occurred.

11:38:18.01 -- Indicates the time the disturbance occurred.

Touch-Screen Buttons

For. -- Pressing this button on the touch-screen or the [F] key advances the display to the next channel that's on. After all the on channels for the event have been advanced to, pressing this button advances the screen to the next event in memory.

Rev. -- Pressing this button on the touch-screen or the [R] key brings you back to the previous "On" channel, and if it's channel A, it brings you back to the previous event number in memory.

Ev.# -- Pressing this button on the touch-screen or the [E] key puts you back to the Display a Stored Event screen.

eXit -- Pressing this button on the touch-screen or the [X] key puts you back to the Main Menu.

More -- Pressing this button on the touch-screen or the [M] key displays the same waveform, but with the rest of the touch-screen buttons displayed (see Figure 2-10 on the following page).

Help -- Pressing this button on the touch-screen or the [H] key brings up an explanation of the touch-screen buttons and their equivalent keys.

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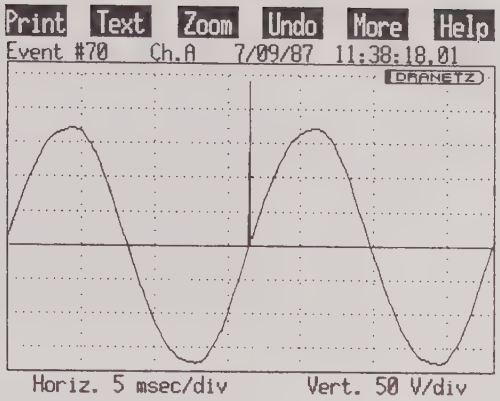

Figure 2-10. Captured Impulse, Second Screen

Print -- Pressing this button on the touch-screen or the [P] key will print the currently displayed graph or text. Pressing the CANCEL button will stop the printing.

Text -- Pressing this button on the touch-screen or the [T] key will give you a description of the displayed disturbance.

Zoom -- Pressing this button on the touch-screen or the [Z] key puts you in the "Zoom" mode, illustrated in Figure 2-11. An explanation of how you position the zoom-box begins on the next page.

Undo -- After a waveform has been "zoomed", pressing this button on the touch-screen or the [U] key brings you back to the previous screen. Before a waveform has been "zoomed", this button performs no function.

More -- Pressing this button on the touch-screen or the [M] key puts you back to the first screen (identical screen but with the the first set of buttons displayed).

Help -- Pressing this button on the touch-screen or the [H] key brings up an explanation of the touch-screen buttons and their equivalent keys.

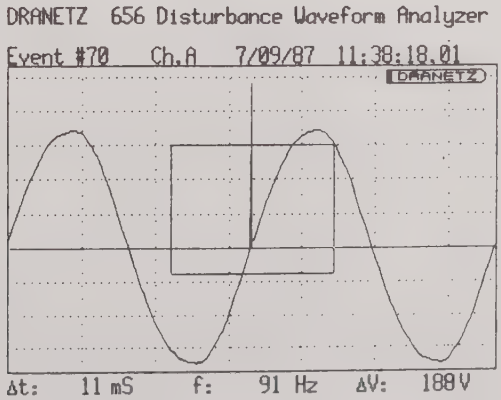

Figure 2-11. Captured Impulse with Zoom-Box

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Text Line Below Screen

When at this screen, the text line below it changes to the following representations:

```
Delta t: 11 mS -- Indicates the width of the zoom-box.
      f: 91 Hz -- Indicates what the frequency of a full
                  cycle framed by the zoom-box would be.
Delta V: 188 V -- Indicates the height of the zoom-box.
```

Touch-Screen Buttons

Print -- Pressing this button on the touch-screen or the [P] key will print the displayed graph. Pressing the CANCEL button will stop the printing.

Zoom -- Pressing this button on the touch-screen or the [Z] key while the zoom-box is on the screen will cause the Series 656 to zoom in on the boxed off region. The region will then be expanded to the full size of the screen. Positioning the zoom-box on the screen is explained below.

eXit -- Pressing this button on the touch-screen or the [X] key will bring you back to the original picture of the waveform, no matter how many times it was "zoomed".

Help -- Pressing this button on the touch-screen or the [H] key will give you an explanation of your possible selections from this screen and what they mean.

Positioning the Zoom-Box

The zoom-box is best operated when it's moved from its initial position using your index finger as described in Subsection 1.2.2. Then, if you want exact accuracy of where you're positioning the zoom-box, use the keyboard for fine adjustments of each of the four sides.

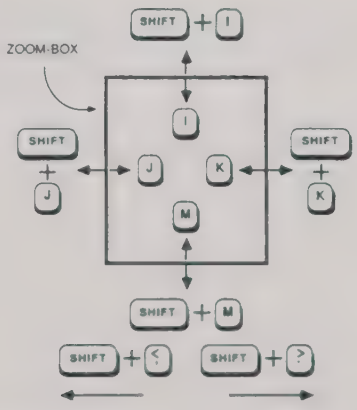

Figure 2-12. Keyboard Commands for Positioning the Zoom-Box

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Using the Zoom-Box to Estimate Disturbance Duration, Frequency, and Magnitude

You can continue to zoom in on the disturbance until you have enlarged it to a size where you can reasonably position the zoom-box around it to determine its duration, frequency, and magnitude.

Each time you position the zoom-box, you should position the sides as close as possible to the disturbance in order to maximize the area to be zoomed. Figure 2-13 illustrates a positioned zoom-box around a disturbance that has been "zoomed" several times.

From the way the zoom-box is positioned, the text below the screen indicates that the impulse is approximately 12 microseconds, its frequency is approximately 41.5 kilohertz*, and its magnitude is approximately 242 volts. (These values are determined by the position of the walls of the zoom-box and change as you change its position; therefore, the closer you "wrap" the impulse with the zoom-box, the more accurate the readings will be).

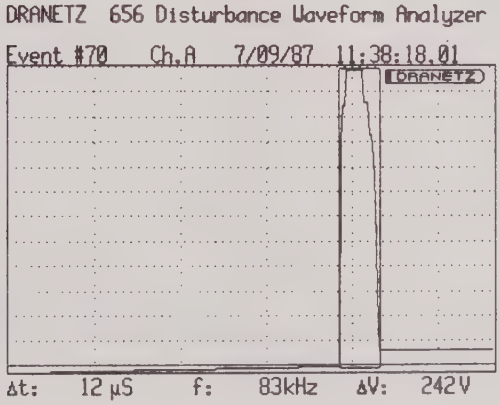

Figure 2-13. Impulse "Zoomed" Several Times

---

* Since the zoom-box is framing a half cycle, the actual frequency would be half of 83 kilohertz or 41.5 kilohertz. The display frequency always assumes the zoom-box is framing a full cycle. If only a portion of a cycle is displayed (such as in Figure 2-13), you must multiply the displayed frequency by the fractional portion (in this case 1/2) of the waveform enclosed within the zoom-box.

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"Zoom" Increments

You could theoretically continue to zoom in on each waveform until you reach either the minimum time (Delta t) or voltage (Delta V) increment: 25 usec/division or 2 V/division. Once this point is reached, the Series 656 will not allow you to zoom in any further.

Table 2-1. Time and Voltage Increments

Time Increments Per Division		Voltage Increments Per Division
25 usec	<---- Minimum ---->	2 V
50 usec		5 V
100 usec		10 V
250 usec		20 V
500 usec		50 V
1000 usec		100 V
2500 usec		200 V
5000 usec		500 V
5 msec		1000 V
10 msec		2000 V
25 msec		
50 msec		
100 msec		
250 msec		

Selection: **2 View Events by Time and Date**

Application: Selection 2 will first prompt you for a date and then a time. The last event in memory which occurred before this time and date is then displayed.

Selection: **6 Return to MAIN MENU**

Application: Selection 6 returns you to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 and 2.

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2.8.3 Status Screen

Selection 3 in the Main Menu brings up the Status Screen. An example of this screen appears below:

```
Status as of 07/09/87 @ 13:14:30
 * * * Monitoring is On * * *
Ch.A   Ch.B   Ch.C   Ch.D   Freq
 On     Off    Off    Off   60.0
Sensor Channels Used: None
Memory: 71 Events (07% Full)
Active Setup: 2  Knob Psn.: 2
Last Event: 07/09/87 @ 11:38:25
Press any key for the MAIN MENU
```

The Status Screen indicates:

- whether monitoring is on or off,
- whether channels A, B, C, and D are on or off,
- the current frequency of the Synchronization channel,
- what Sensor (transducer) channels are being used,
- the number of events in memory and percentage of memory used,
- the currently active setup number,
- the SETUP knob position,
- the date and time of the last recorded event

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2.8.4 Monitoring Functions Menu

Selection 4 in the Main Menu brings up the Monitoring Functions Menu:

```
Monitoring Functions Menu
1 Main Channel Setups
2 Sensor Channel Setups
3 Delete ALL Events in Memory
4 Turn Monitoring On/Off
5 Change Site Information
6 Return to the Status Screen
7 HELP !
```

Possible Selections and What They Mean

Selection: **1 Main Channel Setups**

Application: Selection 1 will bring up the Main Channel Setups Screen:

```
Main Channel Setups
1 Setup #02     A     B     C     D
2 Channels     On   Off   Off   Off
3 Range        Hi    Hi    Hi    Hi
4 Impulse    0150  0150  0150  0150
5 Voltage     010   010   010   010
6 Frequency   0.5 (All Channels)
7 Descrip. Single Phase Standard Setup  A:Line-Neut
(A)ctivate (P)rint e(X)it (H)elp
```

NOTE

When a line or selection is highlighted, if you press [RETURN] before making any changes, nothing on the screen is affected.

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Only the setup matching the SETUP knob position is active when you first start out. For any additional setups you want to activate, you must go into the new setup number, make any changes, and press [A].

Pressing line 1 on the touch-screen or the [1] key will highlight the "Setup" line. You can then use the keyboard keys to change the 2-digit setup number, entering a leading zero or a single digit followed by [RETURN], or repeatedly press the number on the touch-screen. Each time you change the setup number, the entire screen will change to the new Setup Screen.

Pressing line 2 on the touch-screen or the [2] key will highlight the "Channels" line. You can then press the highlighted channel letter on the touch-screen to toggle the channel "Off" and "On". Alternately, you can press the channel letter, [A] through [D], on the keyboard. Note: At least one channel must always be on.

Pressing line 3 on the touch-screen or the [3] key will highlight the "Range" line for voltage monitoring (refer to Table 1-3 for the acceptable "Hi" and "Lo" ranges). You can then press the highlighted channel letter on the touch-screen to toggle the range "Hi" and "Lo". Alternately, you can press the channel letter, [A] through [D], on the keyboard.

Pressing line 4 on the touch-screen or the [4] key will highlight the "Impulse" line. You can then press a highlighted channel letter on the touch-screen to highlight the impulse threshold setting, or press its respective key (press [H] for the acceptable range). You may then type in a new value, pressing [RETURN] if less than four digits.

Pressing line 5 on the touch-screen or the [5] key will highlight the "Voltage" line. You can then press a highlighted channel letter on the touch-screen to highlight the voltage threshold setting*, or press its respective key (press [H] for the acceptable range). You may then type in a new value, pressing [RETURN] if less than three digits.

Pressing line 6 on the touch-screen or the [6] key will highlight the "Frequency" line. You can then type in a new frequency threshold setting, typing a decimal place between the first and second digits, if necessary (press [H] for the acceptable range).

Pressing line 7 on the touch-screen or the [7] key will highlight a 42-character space where you can enter a description of the setup. When you are finished, you must press line 7 on the touch-screen or [RETURN] to accept the new description.

---

* Series 656 voltage thresholds are set for ac rms changes. For dc changes, you must remove the rms factor of ($\sqrt{2}$); therefore, if you are measuring dc voltage, take the dc voltage setting you want, divide it by 1.414, and set it equal to the nearest integer value in the Main Channel Setups. For example: If you want 7V dc as the trip point, set the threshold to 7/1.414 = 5.

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Once you have changed a setup to the new values you want, you must press [A] to activate the setup. If you don't press [A], the old values will remain. You can then press [P] to print the screen, press [X] to exit back to the Monitoring Functions Menu, or press [H] to bring up a HELP Screen describing your possibilities.

NOTE

Whenever you change a setup, you must press [A] to activate it. If you don't press [A], the settings of the old Setup Screen will remain effective.

Selection: **2 Sensor Channel Setups**

Application: Selection 2 will bring up the Sensor Channel Setups Screen:

```
        Sensor Channel Setups
1 Channel ..... 1
2 Status ..... Off
3 Span Value ..... +04095
4 Zero Value ..... +00000
5 Units ..... Deg. F
6 Sensitivity ..... 00.1%

(P)rint      e(X)it      (H)elp
```

NOTE

When a line or selection is highlighted, if you press [RETURN] before making any changes, nothing on the screen is affected.

Pressing line 1 on the touch-screen or the [1] key will highlight the "Channel" line. You can then use the keyboard keys to change the setup number or repeatedly press the number on the touch-screen. Each time you change the setup number, the entire screen will change to the new Setup Screen. Press [RETURN] to accept the value.

Pressing line 2 on the touch-screen or the [2] key will highlight the "Status" line. You can then press any keyboard letter to toggle the reading "On" and "Off". You can also do the same by pressing the highlighted section of the touch-screen. Press [RETURN] to accept the displayed reading.

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Pressing line 3 on the touch-screen or the [3] key will highlight the "Span Value" line. You can then use the keyboard keys to change the span value, pressing [RETURN] to accept the value (press [H] for the acceptable range). How span value is used is described in the fourth paragraph.

Pressing line 4 on the touch-screen or the [4] key will highlight the "Zero Value" line. You can then use the keyboard keys to change the zero value, pressing [RETURN] to accept the value (press [H] for the acceptable range). How zero value is used is described in the fourth paragraph.

Pressing line 5 on the touch-screen or the [5] key will highlight the "Units" line. You can then use the keyboard keys to change the units description. Press [RETURN] to accept the display. How this is used is described in the following paragraph.

Span value and zero value are used in conjunction with the "Units" description to fit the voltage output of the input transducer to a linear equation and to generate appropriate engineering units. Span refers to the nearest integer engineering units output of a transducer at the full scale (10 volts) of the input. The zero value refers to the nearest integer engineering units output of a transducer at 0 volts of the input. Span and zero value setups are signed integers ranging from -32,768 to 32,767. Note: Refer to Appendix B in this manual for examples.

Pressing line 6 on the touch-screen or the [6] key will highlight the "Sensitivity" line. You can then use the keyboard keys to change the sensitivity value, entering a decimal point between the second and third digits, if necessary (press [H] for the acceptable range). Press [RETURN] to accept the value.

You can press [P] to print the screen, press [X] to exit back to the Monitoring Functions Menu, or press [H] to bring up a HELP Screen describing your possibilities.

Selection: **3 Delete ALL Events in Memory**

Application: Selection 3 will first bring up a confirmation screen to verify that this is actually what you want to do (you may want to save your current events to disk before erasing them). If you respond by pressing [Y], all events in memory will be erased. If event scanning is on, new reference events will immediately be recorded.

CAUTION

Once events have been erased, THEY CAN NEVER BE RECOVERED.

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Selection: **4 Turn Monitoring On/Off**

Application: Selection 4 will bring up a message indicating either that event scanning is on and would you like to turn it off, or that event scanning is off and would you like to turn it on. If scanning is off and you want to turn it on, you will be prompted to enter the setup number for monitoring.

NOTE

Event Scanning will automatically be turned off by the Series 656 when its memory is full. Memory is full when there is insufficient room to store a worst case event.

Selection: **5 Change Site Information**

Application: Selection 5 will bring up a message asking you if you want to change the current site information. If you press [Y], you can enter up to a 42 character description, followed by [RETURN]. Once you have changed the site information, all events recorded by the Series 656 from that time on will have the name of the new site. You should change the site information whenever you begin recording events from a different site.

Selection: **6 Return to the Status Screen**

Application: Selection 6 will bring up the current Status Screen. Pressing any key then brings you back to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 5.

2.8.5 Disk Operations Menu

Selection 5 in the Main Menu brings up the Disk Operations Menu:

```
Disk Operations Menu
1 Get Information From Disk...
2 Save Information to Disk...
3 Initialize a New Disk
4 Make a Duplicate Disk

6 Return to MAIN MENU
7 HELP !
```

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Possible Selections and What They Mean

Selection: **1 Get Information From Disk**

Application: Selection 1 lets you load events and setups stored on disk into Series 656 memory. Selection 1 prompts you to place the disk to be loaded into the left-hand disk drive and to press any key. The disk is loaded in less than 1 minute. If no disk is inserted, the Series 656 will time out in 10 seconds.

Selection: **2 Save Information to Disk**

CAUTION

All current data on the destination disk will be destroyed.

Application: Selection 2 lets you save events, setups, or both to disk. Refer to Subsection 2.8.5.1 for information on this selection.

Selection: **3 Initialize a New Disk**

Application: Selection 3 lets you initialize a new disk. A disk must be initialized before any information can be stored on it. You are prompted to insert the disk to be initialized into the left-hand disk drive and to press [Y] to begin. Initialization takes approximately 2 minutes. If you press [N], initialization is aborted.

Selection: **4 Make a Duplicate Disk**

Application: Selection 4 lets you make a duplicate copy of a disk. You are prompted to insert the source disk into the right-hand disk drive and to insert the initialized destination disk into the left-hand disk drive.

Selection: **6 Return to MAIN MENU**

Application: Selection 6 returns you to the Main Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 4.

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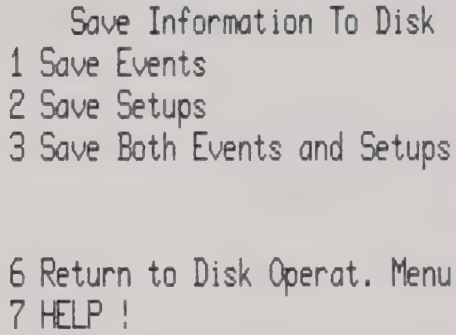
2.8.5.1 Save Information to Disk Menu

Selection 2 in the Disk Operations Menu brings up the Save Information to Disk Menu:



Possible Selections and What They Mean

Selection: **1 Save Events**

Application: Selection 1 lets you save the events in Series 656 memory to a disk. You are prompted to insert the formatted destination disk into the left-hand drive and to press [Y].

Selection: **2 Save Setups**

Application: Selection 2 lets you save the setups in Series 656 memory to a disk. You are prompted to insert the destination disk into the left-hand drive and to press [Y].

Selection: **3 Save Both Events and Setups**

Application: Selection 3 lets you save both the events and setups in Series 656 memory to a disk. You are prompted to insert the destination disk into the left drive and to press [Y].

Selection: **6 Return to Disk Operat. Menu**

Application: Selection 6 returns you to the Disk Operations Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 3.

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2.8.6 Other Functions Menu

Selection 6 in the Main Menu brings up the Other Functions Menu:

```
        Other Functions Menu
1 Set Time and/or Date...
2 Turn Beeper Off
3 Remote Communications...
4 Printer Selection...
5 656 System Tools...
6 Return to MAIN MENU
7 HELP !
```

Possible Selections and What They Mean

Selection: **1 Set Time and/or Date**

Application: Selection 1 will bring up a screen which prompts you for a new time and date for the Series 656 built-in clock. Time must be entered in 24-hour military format and date must be entered in mm/dd/yy format.

Selection: **2 Turn Beeper Off (On)**

Application: Selection 2 will toggle "Off" to "On" and "On" to "Off". When the beeper is on, it sounds every time the Series 656 records an event.

Selection: **3 Remote Communications**

Application: Selection 3 lets you perform various remote communications. Refer to Subsection 2.8.6.1 for information on this selection.

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Selection: **4 Printer Selection**

Application: Selection 4 lets you change the default printer setup from the unit's internal thermal printer to one of the following supported external printers:

Hewlett-Packard ThinkJet,
Epson LX-800
Apple Imagewriter, and
Okidata ML-192

The screen will prompt you for your responses. Refer to Subsection 1.8.2 for more information.

Selection: **5 656 System Tools**

Application: Selection 5 lets you access the Series 656 system tools. Refer to Subsection 2.8.6.2 for information on this selection.

Selection: **6 Return to MAIN MENU**

Attention: Selection 6 returns you to the Main Menu.

Selection: **7 HELP !**

Attention: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 5.

2.8.6.1 Remote Communications Menu

Selection 3 in the Other Functions Menu brings up the Remote Communications Menu:

Remote Communication Menu
1 Wait for a Call
2 Initiate a Call
3 Start Non-Modem Receive
4 Start Non-Modem Transmit

6 Return the Previous Menu
7 HELP!

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Possible Selections and What They Mean

NOTE

Hold down [CONTROL] and press [X] twice to terminate communication with the remote Series 656 at any time.

Selection: **1 Wait for a Call**

Application: Selection 1 prompts you to connect the modem to the Series 656 Main Port and to press any key to initialize it. After a few seconds the modem will be initialized and the Series 656 will remain in the "Wait for a Call" Mode. In this mode it will wait to be called while continuing to monitor for events. Holding down [CONTROL] and pressing [X] aborts this mode.

Selection: **2 Initiate a Call**

Application: Selection 2 prompts you to connect the modem to the Series 656 Main Port and to press any key to initialize it. Once the modem is initialized, you are prompted to enter the telephone number of the remote Series 656 you are calling.

NOTE

Follow the dialing instructions of your modem, being sure to type "T" for tone dialing, "P" for pulse dialing, a comma for the wait-for-dial-tone pause, etc.

If the remote Series 656 you are calling is in the "Wait for a Call" Mode, it will answer on the second ring and a screen such as the following will appear:

```
* * * Remote 656's Status * * *
Monitoring: On Active Setup: 1
Main Channels Used: A
Memory: 33 Events (2% Full)
Site Info: DRANETZ 656 Disturbance Waveform Analyzer
==============================
(G)et remote 656's events
(R)eset the remote 656
e(X)it and hang up the phone
```

This screen indicates the data from the remote Series 656.

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From this screen you have three possibilities:

- [G] Get events from the remote Series 656,
- [R] Reset the remote Series 656, or
- [X] Exit and hang up the phone.

CAUTION

The "Get" command will erase all of your current events and setups and will turn monitoring off; therefore, save these events and setups to disk if you want to recall them.

If you press [G], you will begin receiving events from the Remote Series 656. The total events, received block, and approximate time of transfer remaining are displayed. After transfer is completed, you may exit remote communications and the transferred events will remain stored in your local Series 656. (Events in the remote Series 656 will not be affected.)

CAUTION

The "Reset" command will erase all events in the remote Series 656 and will turn monitoring off.

If you press [R], your local Series 656 will begin resetting the remote Series 656.

If you press [X], you will exit out to Remote Communication Menu.

NOTE

For selections 3 and 4, use a Null-Modem cable if connecting two Series 656s--since both have DCE connectors.

Selection: **3 Start Non-Modem Receive**

Application: Selection 3 puts your Series 656 in an immediate Receive Mode where it awaits the connected Series 656 to begin transmitting data. Note: This selection only applies to direct connect systems, not modem connections.

Selection: **4 Start Non-Modem Transmit**

Application: Selection 4 puts your Series 656 in an immediate Transmit Modem where it begins transmitting to the connected Series 656 waiting in the Receive Mode. Note: This selection only applies to direct connect systems, not modem connections.

Selection: **6 Return to Previous Menu**

Application: This selections returns you to the Other Functions Menu.

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Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 4.

2.8.6.2 656 System Tools Menu

Selection 5 from the Other Functions Menu brings up a prompt for an access code, **DRAN**, to get into the 656 System Tools Menu.

Type: **DRAN** and then press [RETURN]. The Series 656 System Tools Menu appears:

656 System Tools Menu
1 Real-Time Scanning Data
2 Reset and Test Event Memory
3 Restart and Self-Check
4 Touch-screen Calibration

6 Return to the Previous Menu
7 HELP!

Selection: **1 Real-Time Scanning Data**

Application: Refer to Volume 2 of this manual. This selection is applicable to the maintenance of the Series 656, not its operation.

Selection: **2 Reset and Test Event Memory**

Application: Selection 2 prompts you to verify the selection by pressing [Y]. If you do, all of the stored events will be erased and the setups will return to their original factory settings.

NOTE

You MUST calibrate the touch-screen after using this feature.

Selection: **3 Restart and Self-Check**

Application: Selection 3 resets the Series 656 (similar to turning the unit off and then on) and runs the initial diagnostics self-test.

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Selection: **4 Touch-screen Calibration**

Application: Selection 4 lets you calibrate the touch-screen. Since this is part of Section III of this manual, refer to Section III for information on it.

Selection: **6 Return to the Previous Menu**

Application: Selection 6 returns you to the Other Functions Menu.

Selection: **7 HELP !**

Application: Selection 7 brings up a HELP Screen which briefly describes the functions of selections 1 through 4.

2.9 MISCELLANEOUS FUNCTIONS

The following subsections contain information on the miscellaneous functions the Series 656 performs.

2.9.1 Automatic Save to Disk Function

The Series 656 is designed with a feature that allows it to automatically save events to a disk if its memory fills up. For this feature to operate, an initialized disk must remain inserted in the left-hand drive during monitoring. If one is, and if the memory becomes full at any time during the unit's operation, the Series 656 will automatically down load its events onto the disk and clear its memory for more events.

CAUTION

If memory fills up a second time, events will again be down loaded, replacing the current events stored on the disk.

2.9.2 Event Scanning Suspension During Disk Operations

During any disk operations (saving information to disk, getting information from disk, initializing a new disk, and duplicating a disk), the Series 656 suspends event monitoring. Event monitoring will immediately resume when the disk operation is completed.

NOTE

Any events occurring during this time will be held in a buffer and recorded when the disk operation concludes.

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SECTION III
OPERATIONAL TEST

3.1 GENERAL

The Series 656 is designed to automatically perform a diagnostics self-test each time the unit is turned on and to report the results on the Start-Up Screen. The self-test checks out the integrity of the:

- CRT Display RAM,
- Front Panel Interface Board Program RAM,
- Event Memory, and
- Front End Processor Data RAM.

3.1.1 If All Tests PASSED

If no malfunctions are detected, the initial Start-Up Screen displays "PASSED" for the four tests and you are ready to proceed.

3.1.2 If Malfunction(s) Detected

Any malfunctions detected are listed descriptively, along with what action you should take.

NOTE

Refer to Appendix A for a listing of the possible hardware/software error messages.

You should then go to the FACTORY REPAIR subsection in this manual (1.12) for further instructions on contacting Dranetz Service Corp.

3.2 CALIBRATING THE TOUCH-SCREEN

If the touch-screen is not functioning properly, or if you believe the touch-screen has lost its accuracy, you should calibrate it. Follow the instructions in this manual to select the Series 656 System Tools Menu. From the System Tools Menu, select Touch-Screen calibration and follow the prompts to calibrate or test the calibration.

3.3 CALIBRATING THE MAIN AND SENSOR (TRANSDUCER) CHANNELS

The recommended interval for calibrating the Main channels and Sensor (transducer) channels is once every five years. Refer to Volume 2 for instructions or call Dranetz Service Corp. (see Subsection 1.12).

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APPENDIX A

Series 656 Hardware/Software Error Messages

A.1 GENERAL

This appendix contains a listing of the possible hardware/ software error messages that can appear on the CRT screen during operation. Following each error message is the action you should take.

A.2 ERROR MESSAGES

(1) This version of disk software will not work with the current version of ROMs installed. To upgrade the ROMs, please call Dranetz Service Corp. at
(USA) 201-755-7081

(2) A System exception has occurred on the CRT board.

The unit cannot function until it is repaired. Please call Dranetz Service Corp.
(USA) 201-755-7081

(3) A System exception has occurred on the Floppy Disk board.

The unit cannot function until it is repaired. Please call Dranetz Service Corp.
(USA) 201-755-7081

(4) A System exception has occurred on the FPIB board.

The unit cannot function until it is repaired. Please call Dranetz Service Corp.
(USA) 201-755-7081

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(5) A System exception has occurred on the Printer board.

The unit cannot function until it is repaired. Please call Dranetz Service Corp.
(USA) 201-755-7081

(6) A System exception has occurred on the FEP board.

The unit cannot function until it is repaired. Please call Dranetz Service Corp.
(USA) 201-755-7081

(7) A System exception has occurred in Event Memory.

The unit cannot function until it is repaired. Please call Dranetz Service Corp.
(USA) 201-755-7081

(8) A System exception has occurred on the FEP board.

(Applicable message is listed here)

(9) A System exception has occurred on the CPU board.

Turning the unit off and on may correct the problem. If this message appears again, the unit must be repaired. If so, please call Dranetz Service Corp. at
(USA) 201-755-7081

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(10) Sorry, there is a software mismatch in the CPU Software.

Turning the unit off and on may correct the problem. If this message appears again, the unit must be repaired. If so, please call Dranetz Service Corp. at
(USA) 201-755-7081

(11) Sorry, there is a software mismatch in the FEP Software.

Turning the unit off and on may correct the problem. If this message appears again, the unit must be repaired. If so, please call Dranetz Service Corp. at
(USA) 201-755-7081

(12) Sorry, there is a software mismatch in the FEP Software.

The unit cannot function until it is repaired. Please call Dranetz Service Corp.
(USA) 201-755-7081

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APPENDIX B

Example Sensor (Transducer) Channel Setups

B.1 GENERAL

This appendix contains some example Sensor (transducer) channel setups.

B.1.1 Review of Span and Zero Values

Span and zero values are used in conjunction with the "Units" description to fit the voltage output of the input transducer to a linear equation and to generate appropriate engineering units. Span refers to the nearest integer engineering units output of a transducer at the full scale (10 volts) of the input. The zero value refers to the nearest integer engineering units output of a transducer at 0 volts of the input. Span and zero value setups are signed integers that may range from -32,768 to 32,767.

B.2 EXAMPLES

Example 1:
Suppose a temperature transducer is installed that is calibrated to output 10 V dc at 100 degrees C and to output 0 V dc at 0 degrees C. In this simple application, the span value would be 100 (since this is what the transducer would indicate by a 10V dc output) and the zero value would be 0 (since this is what the transducer would indicate by a 0V dc output). If you entered "Deg. C" into the "Units" descriptor setup line (line 5), measurement outputs would be described in degrees C. You could multiply the zero and span values by 10 and put "C * 10" (degrees C times 10) in the units.

Example 2:
A more typical and slightly more complicated application is when the full scale output specification of a transducer is less than the full scale of the Series 656 transducer input (10 volts). Suppose a similar transducer is calibrated to output 6 volts at 100 degrees C and 0 volts at 0 degrees C. In this situation, the span value would be the temperature necessary to produce 10 volts out of the transducer (assuming it was linear and could go that high). Projecting the output to 10 volts would give 10/6 times 100 for a span value of approximately 167. The zero value would still be 0 (same as in the first example). You could multiply the zero and span values by 10 and put "C * 10" (degrees C times 10) in the units.

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B.3 FORMULAS FOR COMPUTING SPAN AND ZERO VALUES

The formulas for computing the span and zero values for an arbitrary transducer where at least two points are specified are as follows:

Span Value =

```
[[(EUF-EUL)/(VF-VL)]*10] + [(VF*EUL)-(VL*EUL)]/(VF-VL)
```

Zero Value =

```
[(VF*EUL)-(VL*EUF)]/(VF-VL)
```

Where:

- * = Algebraic operator multiply
- / = Algebraic operator divide
- EUF = Magnitude in engineering units (1000° C for example) at the full (high) scale output of the transducer
- EUL = Magnitude in engineering units (0° C for example) at the low scale output of the transducer
- VF = Full scale voltage output of the transducer (6 volts for example)
- VL = Low scale voltage output of the transducer (0 volts for example)

EUF, EUL, VF, and VL or equivalent information is generally supplied with the transducer literature. The computed span and zero values must be rounded off to the nearest integer before being entered into the setup. You can multiply the span and zero values by a factor of 10 before entering them into the setup as long as the resultant value is within the range of -32,768 to 32,767.

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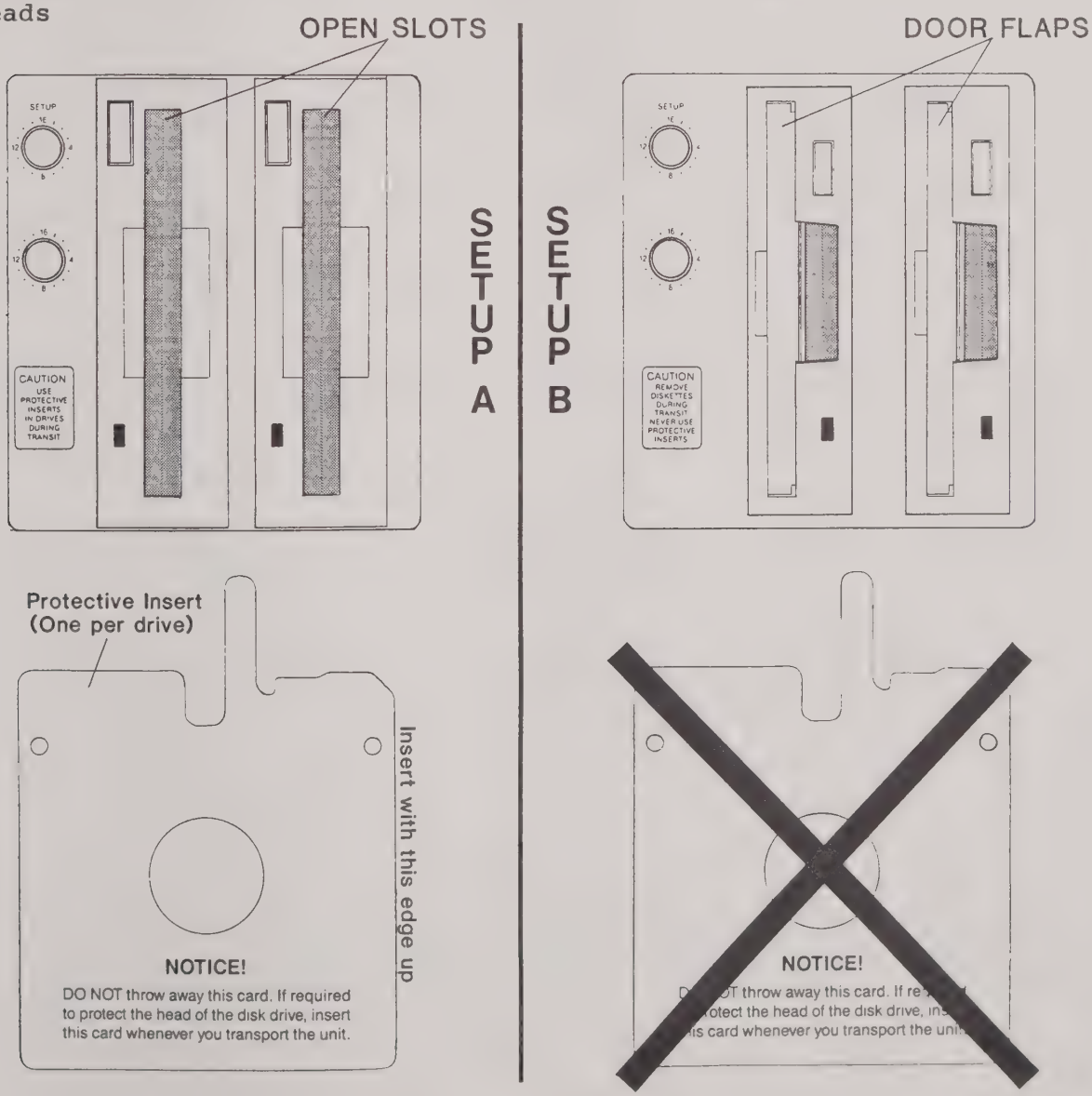
APPENDIX C

Disk Drive Protection

C.1 DISK DRIVE SETUPS

Your Series 656 Disturbance Waveform Analyzer has two possible disk drive setups. Look at the disk drive section of your unit. If it looks like setup A, **ALWAYS** insert the two protective insert cards before transporting the unit to guard the heads of the disk drives against accidental damage. If your disk drive section looks like setup B, **NEVER** insert protective cards into the drives and **NEVER** transport the unit with disks in the drives. With setup B, doing so could damage the disk drive heads


OPEN SLOTS
DOOR FLAPS
SETUP A
SETUP B
CAUTION USE PROTECTIVE INSERTS IN DRIVES DURING TRANSIT
CAUTION REMOVE DISKETTES DURING TRANSIT NEVER USE PROTECTIVE INSERTS
Protective Insert (One per drive)
Insert with this edge up
NOTICE!
DO NOT throw away this card. If required to protect the head of the disk drive, insert this card whenever you transport the unit.
NOTICE!

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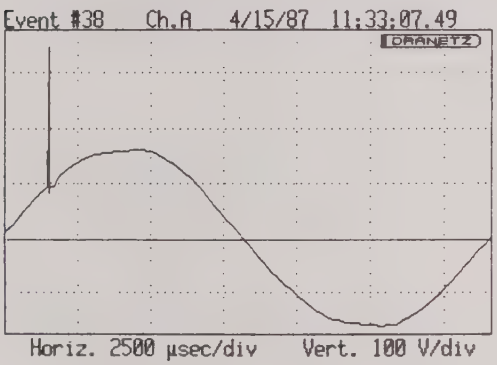
APPENDIX D

Example Waveform Disturbances

D.1 EXAMPLES

This appendix contains various example waveform disturbances and their associated text displays.

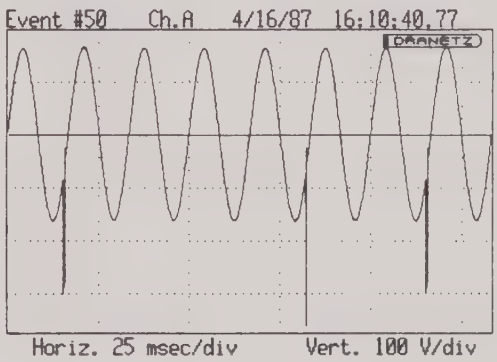
Below is an example single cycle Line A-to-Neutral impulse disturbance with an amplitude of +256 Vpk:



Event #38, Channel A Setup #02
Wed. Apr 15, 1987 11:33:07.49
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=117.0 Vmin=116.3 Vmax=116.3
High Frequency Hits: 1
Worst HF Event:
Amplitude +256 Vpk
Position 33 degrees

Below is an example multicycle Line A-to-Neutral sequence of impulse disturbances with worst case amplitude of -290 Vpk:



Event #50, Channel A Setup #02
Thu. Apr 16, 1987 16:10:40.77
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.1 Hz
RMS Voltages Measured:
Prev. Event=114.5 Vmin=115.1 Vmax=123.1
High Frequency Hits: 3
Worst HF Event:
Amplitude -290 Vpk
Position 335 degrees

In the above displays, "High Frequency Hits" are the number of separate high frequency occurrences in the event. "Position" indicates the sine wave phase position of the worst case high frequency event.

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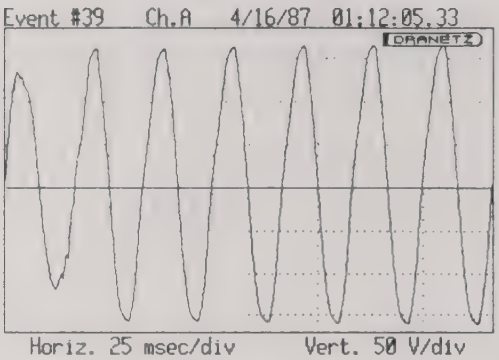
Below is an example single cycle Line A-to-Neutral sag disturbance that reached a minimum of 92.7 V. The beginning of the waveform is the sag and the rest is the waveform after it had returned to within limits:

A.B.C. CO. 3rd floor, Data Comm Room

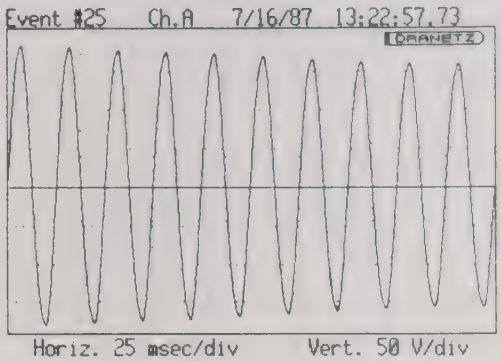


Event #39, Channel A Setup #02
Thu. Apr 16, 1987 01:12:05.33
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=116.3 Vmin=92.7 Vmax=117.5
High Frequency Hits: 0

Below is an example multi-cycle Line A-to-Neutral surge disturbance that reached a maximum of 130.0 V. The beginning of the waveform is the surge and the rest is the waveform after it had returned to within limits:

Dranetz Series 656 <Site Information Here>



Event #25, Channel A Setup #01
Thu. Jul 16, 1987 13:22:57.73
Dranetz Series 656 <Site Information Here>

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=134.7 Vmin=112.5 Vmax=130.0
High Frequency Hits: 0

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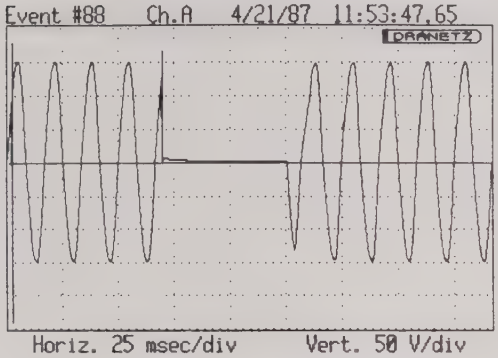
Below is an example multi-cycle Line A-to-Neutral voltage dropout:

A.B.C. CO. 3rd floor, Data Comm Room

Event #88 Ch.A 4/21/87 11:53:47.65



Horiz. 25 msec/div Vert. 50 V/div

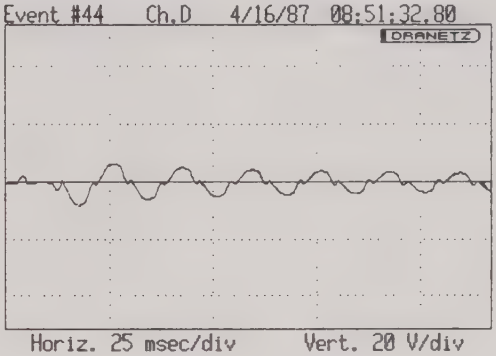
Event #88, Channel A Setup #02
Tue. Apr 21, 1987 11:53:47.65
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=106.7 Vmin=2.5 Vmax=107.4
High Frequency Hits: 2
Worst HF Event:
Amplitude -329 Vpk
Position 42 degrees

Below is an example multi-cycle Neutral-to-Ground RMS disturbance:

A.B.C. CO. 3rd floor, Data Comm Room

Event #44 Ch.D 4/16/87 08:51:32.80



Horiz. 25 msec/div Vert. 20 V/div

Event #44, Channel D Setup #02
Thu. Apr 16, 1987 08:51:32.80
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=1.3 Vmin=2.2 Vmax=3.3
High Frequency Hits: 0

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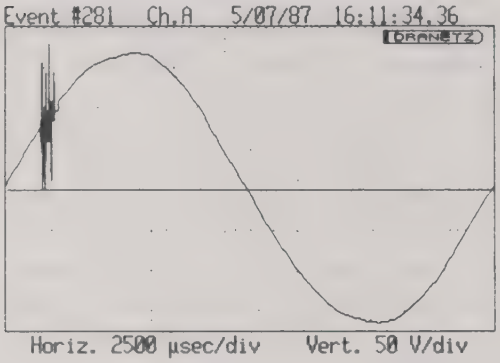
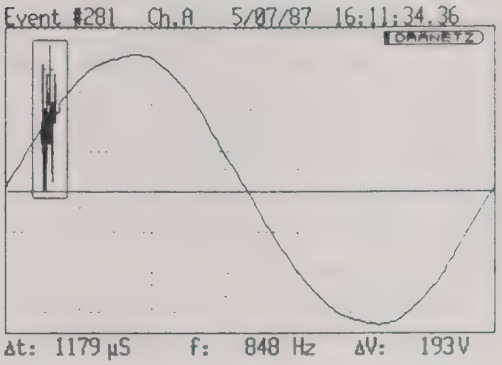
Below is an example Line A-to-Neutral RF "burst" disturbance:

A.B.C. CO. 3rd floor, Data Comm Room



Below is the same disturbance as on the left after the zoom box has been brought up and positioned:

A.B.C. CO. 3rd floor, Data Comm Room

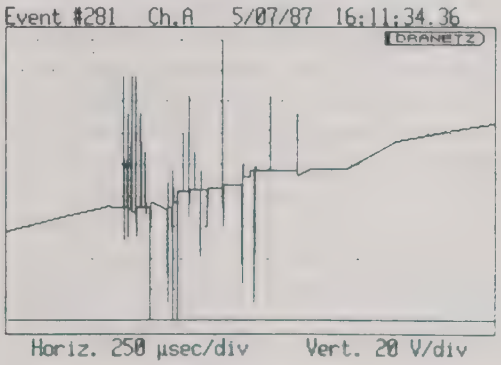


Event #281, Channel A Setup #02
Thu. May 7, 1987 16:11:34.36
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=118.5 Vmin=117.8 Vmax=117.8
High Frequency Hits: 1
Worst HF Event:
Amplitude +94 Vpk
Position 26 degrees

Below is the same disturbance after it has been zoomed:

A.B.C. CO. 3rd floor, Data Comm Room



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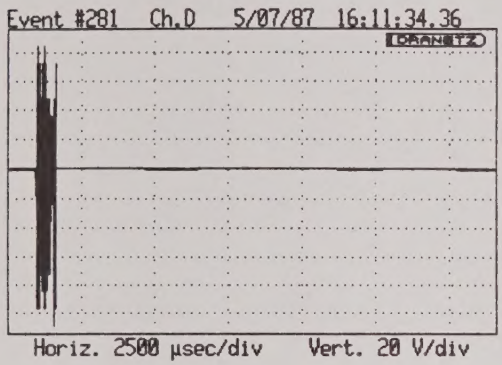
Below is an example Neutral-to-Ground "burst" disturbance:

A.B.C. CO. 3rd floor, Data Comm Room

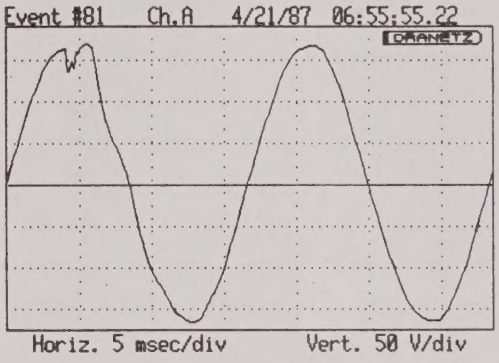


Event #281, Channel D Setup #02
Thu. May 7, 1987 16:11:34.36
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=0.7 Vmin=0.3 Vmax=0.3
High Frequency Hits: 1
Worst HF Event:
Amplitude -108 Vpk
Position 21 degrees

Below is an example Line A-to-Neutral waveform disturbance caused by a load being turned on in the building:

A.B.C. CO. 3rd floor, Data Comm Room



Event #81, Channel A Setup #02
Tue. Apr 21, 1987 06:55:55.22
A.B.C. CO. 3rd floor, Data Comm Room

Avg. Freq. Over 20 Cycles = 60.0 Hz
RMS Voltages Measured:
Prev. Event=119.6 Vmin=118.1 Vmax=118.7
High Frequency Hits: 0

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MP MASTER
MA23123